THE

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1900

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NOW READY.

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THE ELECTRICAL ENGINEERING TRADE IN SOUTH AFRICA.

Now that the war is drawing to a close in South Africa, and two countries of extensive area are about to pass from so-called independence to a part of that whole which constitutes the British Empire—it would not be amiss to take a glance at the new situation with special reference to the possibilities of electrical trade, and to see how the English manufacturer stands with regard to the same.

In considering this question, it may perhaps appear at first sight as if the Transvaal were not the only place where there are possibilities of electrical trade, although the remarks to follow refer mainly to that country—but it is a fact at present that very little has been done in matters electrical outside the Transvaal, with the exception of electric lighting and tramways in four or five of the large towns of the Cape and Natal. What the possibilities of electrical trade are in the future for the back districts of these countries—for Bechuanaland, Rhodesia, and other places—it is almost impossible to forecast. But it may be fairly accurately said that these countries will more or less take their cue from the Transvaal, where there has been gathered together in one district more electrical plant, and no doubt more electrical experience acquired in certain lines, than in any other country of the world, with the exception, possibly, of America.

We may, therefore, conclude that the trade of the Transvaal—which will continue to be the centre of electrical activity—will guide the electrical trade of the other countries into certain well-worn grooves, and the point to be considered is: How does the English manufacturer benefit by this trade?

It is, perhaps, hardly 10 years since the discovery of the rich gold-bearing reefs of the Witwatersrand, but during this period the most marvellous collection of machinery of all sorts has been installed over a line of country about 40 miles in length. The only difference between this collection and the machinery of the Black country is that it is all of the newest and very best, whereas—but let us draw a veil over our own shortcomings. Now, although there is so much of this machinery, there is yet room for a great deal more, as it is a well-known fact that many of the small mines have never been properly developed, and many of the large mines have neglected their extensions and deep levels. The reasons are that of late years the unrest in the Transvaal, and the want of confidence in the corrupt Government, were not conducive to the sinking of fresh capital in machinery. Everyone knew that the struggle must come sooner or later, and most of the mines were content to depend on the machinery they had already got, and await events. This attitude has been justified, as we all know now, and it will not be many months, or perhaps weeks, before the mines will be again occupied,

and the question of new electrical machinery gone into. Then will it be seen how much of the old machinery has been irreparably damaged by neglect and by water; and, inspired by confidence in the new state of things, orders will go out broadcast for this machinery and for plant which the mines have been waiting for years to put down. New schemes will be taken in hand, new districts developed, and, what is more, every bit of machinery will be wanted at once. Now, who is in the best position to supply it?

In the early days of the Rand, things went pretty much the way of the English manufacturer, and direct current dynamos from England tumbled into the country as fast as they could be made. But after a little while there came a change over the scene. The Frankfort Exhibition was held, polyphase dynamos and motors were shown in operation over long distances, and the superiority of this system for the transmission of power was demonstrated. And then slowly but surely the polyphase machine began to get an entrance into the Transvaal, to the exclusion of the direct current plant, and to the benefit of the foreigner. But the English manufacturer made no move; he has hardly begun to do so now. The result is that the trade has largely gone away from England. In the first place the Germans and the Swiss benefitted largely by this new state of things, but they were greatly handicapped by the demand for similar machinery at home. In the meantime, however, the Americans had been adopting polyphase machinery on a large scale, and what is more, standardising and making a special study of it. Being more enterprising than their Continental rivals, they sent men to Johannesburg, and not only opened agencies, but even went so far as to form a supply company for certain mines. What was the result? Americans are as clannish as the Scotch, and it became the case of the unclean spirit who found the house swept and garnished. American machinery required Americans to understand it; the mines engaged them. These engineers required Americans to drive their machinery; they were forthcoming. New machinery was required; specifications were drawn up by the American engineers in their own language and indicating their own type of machinery. English makers could not or would not always quote to new patterns; they had made certain patterns all their lives, and they were not going to change now. To the next thing was but a short step; what more natural than that American dynamos must have American engines to drive them, American pumps to feed the boilers, and to be driven by American motors, and so on *ad lib.* And now the Rand is full of American engineers, American practice is *de rigueur*, and American terms are the vernacular. Specifications are already being handed round for machinery which contain many words strange to our ears, and which clearly indicate their source and the type of machinery required.

Now, where does the English manufacturer stand? Orders for machinery to the value of millions of pounds will be given out in the course of the next year or two, not only for mines, but for towns, which will increase rapidly in size. How many of these orders will he get? Will he strive to get out of his groove? Will he send out or appoint agents who are conversant with the requirements of new countries, or will he continue to try and force them to take the plant he has made for years? It is for him to answer, and not for us, but let it be understood that we do not grudge the Americans their success; it is due entirely to their enterprise and our lack of it that they are now more or less in a position to dictate as to the origin of the machinery required. We only wish to issue a warning in time, now that a new state of things is springing up, so that the English manufacturer may get his fair share of the plums.

Apart from the question of polyphase machinery, which he is now beginning to make, there are many other directions in which he is at a disadvantage with the Americans. Take the question of overhead line equipment, for instance. Why is it that we have to buy so much of this material from the States, not only for the Transvaal, but also for our own requirements at home? Are our own insulator makers energetic enough? Another point, which applies less to the mines than to the towns, is the supply of car bodies and trucks for electric tramways. Hot countries like Africa require open cars, or cars without windows, and with top canopies; are we going to continue to make closed cars only, because the Englishman is satisfied to travel in the summer in a rolling Black-hole of Calcutta, rather than force the tramway companies to put on cars with open sides in the hot weather?

It is not as if the English manufacturer cannot make these things. Indeed, he can make them in every respect as well as the Americans, and the solidity of his work is generally better. But he must standardise his goods rather more so as to offer them at a lower price, and in a shorter time, if he wishes to secure his share in the growing South African trade. There is room enough out there for everybody, but we cannot afford to let our Colonies and our new territories become the dumping ground solely for American machinery—or see all the good posts filled by Americans after we have fought for them ourselves.

The Patent Office and Inventors.—*The Times* understands that the committee appointed by the Board of Trade to consider the various suggestions which have been made for developing the benefits afforded by the Patent Office to inventors, of which Mr. Hopwood is chairman, have presented their report, which has been laid upon the table of the House of Commons and will be published in the course of a few days. The committee recommend that classified illustrated abridgments of all specifications from 1617 to 1883 should be made and the work completed by the end of 1906; that volumes of collected abridgments for each of a limited number of leading subjects of invention should be placed in the Patent Office as an experiment; that no action should be taken as regards the issue of reminders for payments of patent renewal fees; that authority should be given to the Comptroller-General to reprint specifications of expired patents for which there is a demand; that a system of deposit accounts for Patent Office publications should be experimentally adopted; that the annual allowance for the purchase of books and for binding for the Patent Office library should be increased for the next three years, and that a special sum should be allowed for the purchase of books already selected but which cannot be supplied for want of funds.

The Royal Society.—Among the papers read yesterday afternoon were:—

"On the Connection between the Electrical Properties and the Chemical Composition of Different Kinds of Glass." Part II. By Prof. A. Gray, F.R.S., and Prof. J. J. Dobbie.

"On the Change of Resistance in Iron Produced by Magnetisation," by Prof. A. Gray, F.R.S., and Prof. E. T. Jones.

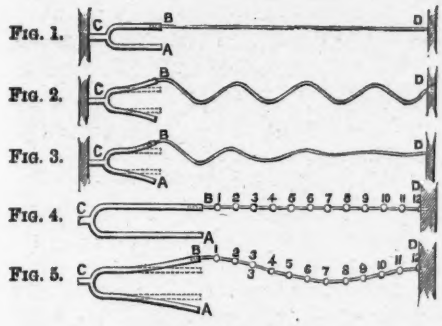
"Underground Temperature at Oxford in the Year 1899, as Determined by Five Platinum Resistance Thermometers," by Dr. A. A. Rambaut, F.R.S.

"Lines of Induction in a Magnetic Field," by Prof. Hele-Shaw, F.R.S., and A. Hay.

DR. PUPIN'S IMPROVEMENTS IN LONG-DISTANCE TELEPHONY.*

By HERBERT T. WADE.

Soon after the laying of the first Atlantic cable, nearly 50 years ago, Sir William Thomson prophesied that it would not be possible to exceed a certain rate of speed in the transmission of signals, on account of the so-called capacity of the cable. This prophesy has held good, for notwithstanding multiplex and mechanical systems of telegraphy on land, the submarine cables are operated at an average speed of but 25 words a minute. The use of a submarine cable in telephony over a



greater distance than 27 miles in length (Dover-Calais) is not supposed to be practicable†, and consequently telephonic communication is not available where a large body of water must be crossed. In telephone circuits where aerial wires are employed there are also limitations, and yet long-distance telephony on such a scale as is desired from New York to New Orleans or San Francisco, for example, has not been attained, and is admitted by telephone engineers to be next to impossible.

After a series of experiments performed at the laboratory for electro-mechanics at Columbia University, Prof. M. I. Pupin has ascertained that with cables and air-line conductors constructed according to a method thus far employed in the construction of long-distance electrical conductors, which involves a somewhat radical, but, nevertheless, a very simple departure from the methods, the efficiency of transmission of electrical energy is greatly increased, and that a number of the difficulties just enumerated may be readily overcome. The

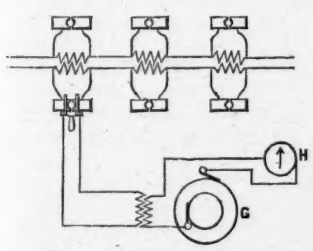


Fig. 6.

method may be stated broadly to consist in employing what Prof. Pupin calls non-uniform conductors in place of ordinary uniform conductors. In the course of his experiments he has made use of such conductors for long-distance telephony, and the researches in his laboratory have been marked with great success.

Electrical energy, when sent over a conductor of such length as is used in long-distance telegraphy or telephony, is transmitted in the form of electrical waves. The transmission of the energy under such conditions can hardly be called direct, for it is first stored up in the medium surrounding the transmission line, and from here it is then transferred to the receiving apparatus. If a periodic current is impressed on the circuit by the transmitting generator, we have periodic variations of current and potential along the transmission wire.

In the study of electrical waves it is found that the amplitude of the wave diminishes as the energy is propagated from the source. In short, a weakening of the current is caused which is styled attenuation, and for the constant of attenuation there is a mathematical expression in which the inductance, resistance, and capacity of the conductor, and the frequency speed figure. The loss of energy is due to the imperfect conductivity of the wire, and it is regulated by the inductance and capacity in the circuit. The most important feature of this regulation is the following: If a conductor has a high inductance, a given quantity of energy will be transmitted with less loss than over a conductor with

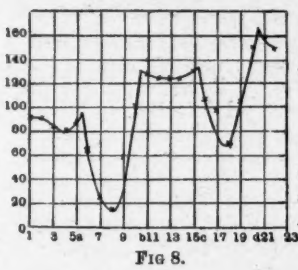


Fig 8.

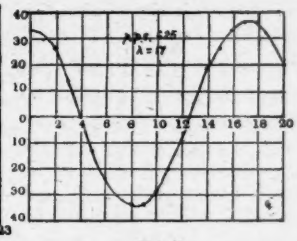
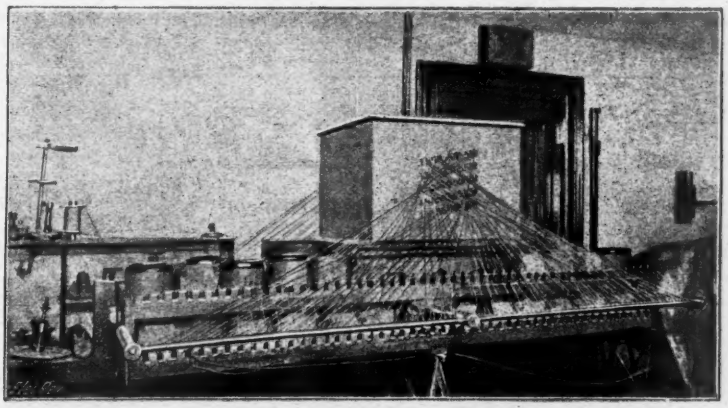


Fig 7.

a smaller amount of inductance. This fact was known to Oliver Heaviside, the mathematical physicist of England, and while his theory demonstrated the superiority of a wave conductor of high inductance, it did not indicate a way in which such a conductor could be constructed. The mere introduction into the circuit of a coil or coils has been tried without success, as there was no underlying mathematical theory to govern the experiments.

Prof. Pupin, however, has developed such a theory, which serves to explain the problem, and its main features are well shown in a mechanical illustration in which the same elements are present as are found in the question of the transmission of electrical waves. To one prong of a tuning fork rigidly fixed at C is fastened a cord whose other end is attached to some firm object as D, shown in the illustration (fig. 1). Let the fork be set into vibration, and a



250 miles artificial line, with inductance coils at one mile intervals.

Fig. 9.—Experimental Cable with Inductance Coils.

wave motion results, which, if the resistances due to friction are negligible, will take the form of stationary waves, as shown in fig. 2. But assuming that the frictional resistances are not sufficiently small to be neglected, then the direct and reflected waves will not be equal, and instead of stationary waves there will be waves where the amplitude of the particles at the greatest distance from the tuning fork will be less than that nearer the source of motion, as

E

* *Scientific American.*

† This is incorrect, as good speaking through more than double the length of this type of cable is known to be perfectly practicable.—Eds. Elec Rev.

shown in fig. 3, the energy being dissipated by the frictional resistances in its progress along the cord. This weakening or attenuation, however, will be diminished if a string of greater density is employed, since a larger mass requires a smaller velocity in order to store up a given amount of kinetic energy, and a smaller velocity occasions a smaller frictional loss. Now let a weight, such as a ball of wax, be attached to the vibrating cord at its middle point, so as to increase its mass. This weight will serve to occasion reflections, and there will be far less energy transmitted to the extremity of the string than before. Then, if the mass of wax be sub-divided and put at regular intervals, as shown in the diagram (fig. 4), the efficiency will be increased. The further we proceed in this sub-division the higher will be the efficiency of transmission, but a point will be soon reached beyond which it is not possible to secure an appreciable improvement by further sub-division.

This point is where the cord thus loaded vibrates very nearly like a uniform cord of the same mass, tension and frictional resistance, as we may see by reference to fig. 5. Therefore, to secure an increase in the efficiency of transmission over a cord thus loaded, we must properly subdivide the load and the distances, or otherwise the effects of reflection will destroy the benefits derived from the increased mass. In the experiments with the cord it was found impossible to load the cord in such a way as to make it equivalent to a uniform cord for all wave lengths. but if the load was distributed so that it satisfied a given wave length, it also answered for all longer wave lengths. The mathematical theory and law for the vibration of a cord under such conditions is exactly the same as that governing the distribution of the electric current over a wave conductor under the influence of similar forces, kinetic or mass reaction, tensional reaction and resistance reaction in the case of the cord being paralleled by electro-kinetic reaction, capacity reaction, and ohmic resistance reaction in the case of the wave conductor. Therefore, it will be understood that if inductance coils are introduced along the wave conductor at periodically recurring intervals, the efficiency of the transmission of electrical energy is increased. Prof. Pupin's conclusion is that a non-uniform conductor is as nearly equivalent to its correspondingly uniform conductor as $\sin \frac{\phi}{2}$ is to $\frac{\phi}{2}$, where ϕ is the angular distance between the inductance points of inductance sources and the angular distance to 2π corresponds with the wave length. Here the value ϕ is inversely proportional to the wave length, so that for a given distance between the reactance points the degree of equivalence diminishes as the wave length diminishes. If the wave conducted be of complex nature, such as is met with in telephony where the overtones of the voice are present, then, if the approximation suffices for the highest essential frequency, the conditions will be even more favourable for the lower notes.

From theory to experiment was the next step in this investigation, and the study of these electrical waves was undertaken while they were passing over wave conductors. The experimental proof consisted in demonstrating that non-uniform conductors of the description just given will show the same wave length and the same attenuation for a certain frequency and for all lower frequencies as a uniform conductor of the same inductance, resistance, and capacity. The wave length is, of course, conditioned by the frequency, and in the construction of the apparatus the periods used in long-distance telephony were selected. The conductor selected was the counterpart of a cable 250 miles in length, having the equivalent resistance and capacity. To construct such a cable was a task of much labour, and three cables were made and experimented with, before the final form was reached which approaches very nearly the conditions existing in a submarine cable. This was formed of thin strips of tin-foil laid on sheets of paraffined paper and carefully connected, their length being sufficient to afford considerable resistance, while the capacity was regulated by the thickness of the insulating material. The strips were then connected in sections, each being equivalent to one mile of cable with a resistance of 9 ohms and a capacity of ·074 microfarad, and were arranged in groups of 50, one such group being contained in the heavy case shown in the centre of the illustration, fig. 9. Having a cable where there is resistance and capacity, it is possible to demonstrate experimentally the vigorous attenuation of the current and to study the propagation of the electrical waves. This attenuation, as has been said, is remedied by the insertion of inductance coils into the circuit, and the illustration and diagram show the method of adding such coils. The wires from the various sections of the cable are connected with brass plates placed on a long wooden strip and by means of plugs and binding posts the circuit can be regulated. At the gap between any two successive sections of the cable a coil or coils containing inductance can be added, and by merely inserting a plug can be cut out of the circuit. Using a small alternator, and circuits with suitable inductance and capacity, to impress a simple harmonic electromotive force, the waves were investigated. The alternator was so constructed as to give currents of different frequencies and thus produce the circuit waves of different length. Then with a slide contact, G, and galvanometer, H, arranged as shown in fig. 6, it was possible to ascertain the condition of the current at any point along the line. In this way observations were made and curves plotted showing the maximum and minimum amount of current and the length of the wave passing along the conductor. Such a curve is shown in fig. 7, the numbers along the horizontal line in the middle representing the distance from the middle point of the cable, and the dots the current at various distances from this point.

Connecting these points we have a close approximation to an attenuated sine curve as required by the mathematical theory. In this case the wave length is 17 miles and the frequency 625 periods per second. Contrast this with the following illustration where the inductance is not properly placed in the circuit, and the result shows a remarkable attenuation and reflection of the waves. Leaving the exact mathematical considerations out of the question it may be stated that if the induction coils are placed at intervals about $\frac{1}{16}$th of the wave length the non-uniform conductor will be like a uniform conductor to within two-thirds of 1 per cent. If this is done the attenuation is made very small, comparatively speaking, and the electrical energy is transmitted with but slight dissipation. A numerical example will illustrate this more clearly. If the cable is employed with the inductance coils placed properly, then $2\frac{1}{2}$ per cent. of the current generated at the transmitting end reaches the receiving end of the cable. But if the coils are cut out and the cable used in the ordinary way, then only $\frac{1}{250000}$th part of the current sent in at the transmitting end reaches the receiving end. In other words, the insertion of the coils enables the cable to transmit 6,000 times as much current.

The first application of the results of this investigation has been to long distance cable telephony. The cable being employed as before with the inductance coils at intervals of one mile, and at either end of the line two sets of ordinary telephonic instruments. Over this line of 250 miles of cable one can carry on a conversation distinctly, the fact seeming the more remarkable when it is realised that about 40 miles * is the present limit for cable telephony and that the longest cables in the New York subways are 15 miles in length. These experiments from a purely scientific point of view demonstrate the feasibility of trans-Atlantic telephony.

It is, however, in regard to its applicability to telegraphy, that its advantages for marine work must be especially considered, where, as soon as the speed is increased the attenuation of the waves occurs and a limit is very early set upon the rate of operation. With the attenuation taken care of by inductance coils added at specified distances along the cable, the current would be transmitted with small loss to its destination and not only would the ordinary speed of operation be increased, but by the use of methods similar to those employed on land for rapid telegraphy the efficiency would be made many times greater. The inductance coils could be added to the conductor at certain distances and placed within the sheathing at small expense in comparison with the cost of the cable, and being made about 1 inch in diameter and 6 inches in length would create no particular difficulty either in the manufacture or in the laying of the cable.

The earliest application of this method will doubtless be to aerial conductors to increase the present limits of long distance telephony now placed at St. Louis from New York.

* This is incorrect, the "K R" of 125 miles of the artificial cable would be 10,406, through which speaking would be perfectly practicable.—EDS. ELEC. REV.

The inductance coils at slight cost can be attached to the cross arms of the poles and instead of the heavy copper wires now required, a smaller and less expensive conductor may be used. According to the theory and its experimental verification, there seems to be nothing to prevent a very wide increase in the limiting distance of modern telephony through the use of this method of constructing conductors, and trials in the field under actual conditions of service are anticipated with interest by telephone engineers. It is worthy of notice in connection with this discovery that its entire development has been carried on along strictly scientific lines by Prof. Pupin, to him being due the conception of the mathematical theory involved, its experimental verification, and lastly, its application to an important technical problem.

ENGLISH ELECTRICS.

Our pages for some weeks past have borne eloquent testimony to the strenuous efforts which are being made on all sides to develop the applications of electricity to the transmission of power and the better provision for traffic of every kind; and as Parliament has shown a decided tendency to look kindly upon the power schemes which have been brought forward, there is every encouragement for promoters of genuine enterprise to persevere in their endeavours. Moreover, the success of legitimate undertakings in these branches of the electro-technical industry may have a great bearing on the chances of again securing to England that supremacy in the industries of the world with which she has been usually associated, and the premier position in engineering of which she has been partially but, may we hope, only temporarily dispossessed by American and Continental competition.

Circumstances as they exist to-day may not be particularly pleasant to our national pride, therefore we must look about us and see whether our industrial organisations are in all ways suited to the conditions now prevailing.

It is, however, with Great Britain's electrical engineering that we are more directly concerned, and we gladly note the activity which now prevails, not only in the direction of transmitting cheap motive power over long distances, but in electrical railway and tramway operations.

The Central London Railway is just on the point of being opened to the public, and with such benefit to Londoners as has not yet been fully recognised.

Central Londoners, said the *Daily News* last Saturday in a popular but instructive article on London's new railway, had long lacked swift communication between the City and the western suburbs. Neither the Metropolitan nor the Metropolitan District Railway is of any real use to the Londoner who lives in the centre of the wide circle they form, at a wide radius from the most important residential and business districts, but until now nothing was left for one who desired to travel, say, from the Oxford Street end of Tottenham Court Road either to Shepherd's Bush or the City, but a choice between cab and omnibus to any one of the desired points. To journey either to Charing Cross in one direction, or to Gower Street in the other, for the purpose of reaching the rail, meant at least as lengthy a transit as it would have involved to proceed directly by those horsed conveyances to one's destination, a trip occupying over half an hour under the most favourable circumstances. Cab fare for the distance to which the Central London Railway runs comes to at least 3s. 6d., while the omnibus journey costs 5d. From the opening of the line it will be possible to travel the whole way, in less than half the time, for 2d.

The experimental section of electrical line on the Underground system between Earl's Court and High Street, sneered at though it is by unreasoning critics, is a move in the right direction, and numerous other schemes in contemplation are rapidly approaching the time of fruition. Only yesterday the members of the Municipal Electrical Association, in solemn conclave, were discussing the vexed and much debated question of combined management of tramways and lighting departments, and everywhere electric locomotion is becoming an all-absorbing topic.

Speaking generally, the greatest activity is visible in electrical movements of all kinds, and, in the opinions of those closely associated with the various schemes afoot, and therefore the best able to judge, this country will be the field for some years to come of such enterprise and development as will compare with the palmiest days of electrical "booms" in the United States.

And here we may be pardoned for alluding to the strong feeling which has existed for several years against American practice and American consulting engineers, now happily abating. When we were rudely awakened to the fact that our manufacturing firms were not in a position to give us generators and motors suitable for the best tramway methods as they existed in the States and in Continental towns, we were compelled, reluctantly enough, be it said, to fall back upon American standard machines. To those brought up in the belief that in all things English engineering was supreme, the blow was a severe one, and our dislike to the American invasion was resented in no measured terms.

But the lapse of time has fully shown our unpreparedness, and though our pride was wounded, we have become reconciled to the fact that what has happened has been for the best, and every uncharitable feeling towards the American engineers who showed us what to do, and how to do it, should be relegated to the past, for we are now in a better position to reap the benefit of their skill and years of experience in a matter with which our engineers had previously no practical acquaintance.

We had flattered ourselves that not a few of our English manufacturers of old-established repute were fully equipped to undertake anything that came along; the scales have fallen from our eyes, and it is plainly to be seen that to keep abreast of the times we must relax our policy of masterly inactivity, or we shall be compelled to make strategetic movements to the rear.

Having read, learnt, and inwardly digested the lesson which American engineers and their methods have taught us, there are those who intend to profit thereby, and the latest development in the direction of securing to this country work which would otherwise go abroad, is the undertaking of the English Electric Manufacturing Company, whose extensive, unique and magnificently equipped works we describe in our other columns.

Purely, and we might add militantly, an English undertaking employing only British labour, it will be run on lines evolved from the best American and Continental practice, controlled by an American works manager, and English foremen with United States experience.

The technical director to the company is well known to readers of the Electrical Review, as is his life's work, and we may be sure that with his experience as a pioneer in electric traction, aided by his reputation of being an up-to-date authority, the company will have the benefit of the highest skill in their designing departments.

The object of the American manufacturer is to supersede manual labour by labour-saving automatic tools, and money is not allowed to stand in the way where it is felt that an adequate return may be anticipated; this is the feeling which animates the directorate of the new company, and just as is the case in the States, it is believed that British workmen, when freed from pure drudgery, will perform work of a higher order in which their innate intelligence will be called into operation. So far as experience has shown, the results at Preston have been more than satisfactory, and the American superintendents declare that the Britisher working here under American labour conditions, is a better all round man than his trans-Atlantic cousin, and the works' output is materially increased.

With the finest machine tools that can be procured and the best practice in factory organisation, the company will be enabled to compete on equal terms with the prices current in the United States, and there will be no longer any need for purchasers to go outside old England for standard equipments for railways or tramlines, nor for consultants to specify for goods which they know could hitherto only be supplied by trans-Atlantic companies. Managers of departments, engineers, and the staff generally, are men of the greatest experience in every detail of the company's operations, and we welcome the advent of the English Electric Manufacturing Company, as the pioneer undertaking of the kind, which should speedily render England independent of outside assistance for the carrying out, in a manner second to none, of the largest electrical undertakings, whether in lighting, locomotion, or of

centre of the illustration, fig. 9. Having a cable where

ticable.—EDS. ELEC. REV.

the electrical transmission of power, and reassert the old country's once pre-eminent position in the world of engineering.

THE LIGHTING OF SMALL TOWNS.

Two papers were read on Wednesday before the Municipal Electrical Association on the subject of lighting small towns by electricity. The ideas of the authors as to what is a small town seem to vary considerably, one of the writers being inclined to include towns up to 40,000 inhabitants.

We think that any town of 20,000 population and upwards can scarcely be called a small town from an electric lighting point of view, as there should be no difficulty in establishing a successful undertaking in towns of that size. The real problem is how to deal with towns of a population of from 4,000 to 10,000, of which there are a large number waiting to be taken in hand.

Of the two papers, that by Mr. Harris seems to be the one which really meets the question under discussion; the other, by Mr. Vesey Brown, dealing only with generalities, would apply to towns of any size.

Mr. Harris at the commencement of his paper suggests that the success of an undertaking in a small town should not be judged "by actual return made in the shape of profit shown, but upon truly municipal lines." He seems to mean by this that the street lighting should be thoroughly well done without reference to cost, and that the supply for private use should be a secondary consideration. We, on the contrary, think that an undertaking is not justified unless it can be worked successfully on commercial lines without coming on the rates for support, and that a cheap supply of electric energy, both for lighting and power purposes, should really be the first consideration.

The difficulties to be overcome in making a small station successful are two—one Mr. Harris very properly points out is the large capital expenditure required in proportion to the sale of current, and the second, which the writer does not seem to appreciate, is the large proportionate cost of labour.

It is very difficult to obviate either of these drawbacks. The capital charges may be kept down by avoiding unnecessary elaboration in the plant, and also by omitting the usual duplication and running the risk of any breakdown; whilst the labour charges can be reduced by combining with the production of electricity the business of supplying and fitting up the lights which are required by the consumer, or, in other words, adding a contractor's business to the ordinary business of a supply station, the same men who are employed in running the station being also employed for carrying out installation work. Whether a local authority has power to undertake this branch of the work is a matter of doubt, and on this account it seems to us that companies are able to undertake the work in small towns more advantageously than a local authority.

As to the system of laying mains underground in the manner suggested by Mr. Harris, we think there will be considerable difficulty in obtaining the Board of Trade's sanction to such a system, but in an outlying country district there ought to be no objection to allowing a certain proportion of the mains to be carried overhead, although it is a question whether, in this country, there is really much economy in carrying overhead wires, the saving in first cost being but small and the cost of the maintenance being much heavier in proportion.

CHARACTERISTICS OF THE SUCCESSFUL STREET RAILWAY MANAGER.*

THE crying need to-day is for managers. The country is being carefully searched by syndicates and great bankers for men who are able to successfully handle the great street railway and lighting properties which have been formed by consolidations. Hardly any price is considered too much to pay for "the right man in the right place." The "war horses" of the industry are few, and it is evident that the younger crop of managers who have hitherto been in charge of comparatively unimportant properties, must be looked to for material for the larger positions if this extraordinary demand is to be satisfied, particularly if the foreign need for trained electric railway managers is taken into account.

What, then, are the characteristics of "the man of the hour?" What is it that capital wants in the one to whom it is about to entrust its interests?

First, and most important of all, *honesty and loyalty*. By this is meant not only the common honesty and loyalty which will prevent a man from becoming a thief, or keep him from wrecking a company to his own advantage, but the rarer sort that will be absolutely faithful to the interests of all the stockholders. It is not an easy thing for a manager to avoid the temptation of using the information which he obtains first hand for his own private benefit—in the stock market, for example—and it is not an easy thing to avoid attaching himself to some powerful clique of stockholders which is seeking to enrich its members at the expense of the others. It is the hardest thing of all, perhaps, to say "No" when a director or stockholder, who has been constantly friendly to the manager, and has helped, perhaps, to put him into his position, asks a favour of him which is on the ragged edge of dishonesty or disloyalty—a favour which he can perhaps grant without too serious qualms of conscience, but which he knows in his inmost heart is against the interests of the entire body of stockholders.

And yet it is honesty and loyalty of this higher order which, in the long run, brings to a man the confidence and respect of the financial world, and puts him into the highest positions of trust. Business history is full of mushroom successes, made by questionable methods, and followed by wrecks of fortunes and of reputation—and street railroading has furnished not a few of such cases.

The next most important characteristic of a successful street railway manager is a *sincere regard for his employés*. The latter will detect Pharisaism and insincerity more quickly than is often believed, and no matter how much a management may do for the physical welfare of its men, unless the motive is genuine regard and not policy, the effort will fail. The successful management of labour has so many points of bearing upon the entire financial success of the undertaking, that its importance cannot be overestimated. A strike is a thing to be dreaded and avoided as a plague, for not only is the direct loss heavy, but the after-effects often last for years in "soreness" among the men, boycotting in more or less extended forms by the public, hectoring by the newspapers, and perhaps a bitter warfare by the politicians, who see in a company's unpopularity their chance for success. In every way possible a manager should seek to attach his men to him, and win their genuine respect and devotion by little acts of personal kindness as well as the larger ones.

The next characteristic is *force and decision of character*. The undecided and vacillating man will never be able to handle an important business proposition. If he gets lost in the meanderings of a muddy intellect, he is a failure, no matter how wise his final decisions may be. The modern demand is for quick, sharp, decisive action, and the intellect must be so trained as to work straight to the point, without unnecessary flounderings.

Organising ability is, of course, a most important requisite. Many men think they have organising ability of a high order, but in the final analysis it is frequently found that their idea of an organisation is complex and not simple, expensive and not cheap, and too delicate in its operation. Theoretically, an organisation so created may be well balanced and symmetrically excellent; practically, it breaks down at important points, or is inordinately costly. "By their fruits ye shall know them," and the manager whose organisation only costs 2½ per cent. of the gross receipts, where another's doing the same work, costs 5 per cent., is justified in most cases in believing that his "organising ability" is the greater.

Diplomacy in dealing with the public belongs in the first rank of success characteristics. The manager who is bright, cheerful and jovial in temperament—who will meet the public fault-finder with courtesy and a bright optimism which turns a possible enemy into a friend, is far more

* *Street Railway Journal.*

likely to give a good account of his trust to his stockholders at the end of a term of years—is far more likely to neutralise efforts at municipalisation, for example—than is the man who receives all visitors with a stern, frigid, suspicious air, which seems to say, "I suppose you are another one who thinks he can run my business better than I can." One of the first inquiries that will be made by the banker proposing to engage a manager is always, "Is he a diplomat?"

Some insight into the engineering questions upon which a manager will be called upon to pass final judgment is almost an essential in these days, but it is not necessary that such an insight should be obtained through direct technical training. Engineering problems, after all, call chiefly for good common, business "horse-sense," and the pure technicalities are few. Engage an engineer—the best you can find—to help you with these technicalities, but keep a sharp eye upon his expenditures and recommendations for expenditures. If you find an engineer who has got horse sense and doesn't make too many mistakes, cherish him as the apple of your eye, and pay him whatever he asks—he is worth it.

To these major characteristics of a successful street railway manager, must be added, of course, many minor ones, which have a more or less important bearing on results. The best advice which can be given to the young man ambitious to make his mark in the street railway world is to *never accept a position where success is impossible, and never leave it till success has been achieved.* The thing which brought Grant, against most determined opposition, to the head of the Federal forces, was his unbroken record of successes. The best reputation which any man can get in his business life is that of uniform success in carrying out his undertakings—the worst reputation is that of failure, or of running away from an expected failure. To a man situated in an uncomfortable position, where factions oppose and difficulties come thick and fast, an offer of a better position at a higher salary in more congenial surroundings, comes like a ray of light, and is a temptation rarely resisted. It is almost always a mistake, however, to yield to it, because not only is the success record broken, but the man has missed his chance of gaining that most valuable of all experiences—the overcoming of apparently insuperable obstacles.

Honesty, loyalty, organising ability, decision of character, diplomacy, persistence and grit—these qualities, together with a genuine regard for, and sympathy with the men through whom in large part success is to be achieved, are the characteristics of the successful street railway manager.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be as brief and concise as possible. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

A FIRM of electrical engineers write:—"We have an opportunity of renting a water mill with which we could doubtless light up a village within 3 miles of the power. The land over which we should carry the wires belongs to the proprietor of the mill. We should, however, have to get the consent of the Parish Council to lay the wires in the roads of the parish which we do not anticipate will be refused. We should be obliged to you if you would inform us whether it will be necessary to obtain the consent of the Board of Trade. We take it that we stand in this position: That we are traders having a commodity to dispose of to any customer, and if we can arrange with the local authorities is there any necessity to trouble the Board of Trade on the matter?"

*** In answer to the above question, we have come to the conclusion, although with some hesitation, that there is nothing in the Electric Lighting Acts, 1882-1899, which renders it *compulsory* to obtain the leave of the Board of Trade for the purpose of laying down an electric installation. A careful perusal of the Acts shows that in so far as they confer powers upon the Board, they are enabling only. We do not, however, think that our correspondents would be wise in establishing their installation without, at least, giving notice to the Board of Trade of their intention to do so. A reference to S. 4 (1) of the Electric Lighting Act, 1888 (51 & 52 V., c. 12), will serve to show that where any electric lines or other works may have been laid down in streets, or in such a way as not to be enclosed in a building, otherwise than in accordance with and subject to the provisions of a license, order, or special Act, the Board of Trade may cause a notice to be served upon the undertakers requiring them to continue their works, and supply their electricity only in accordance with conditions and regulations prescribed by the Board of Trade for the safety of the public and the protection of the property of the Postmaster-General. Seeing that they would render themselves liable to the service of a notice of this kind, we are tempted to recommend our correspondents to apply for a license or provisional order in the ordinary course. Should they feel disposed to act without the sanction of the Board of Trade, we can only advise them to take a legal opinion as to the liabilities incident upon such a course. In the absence of a further statement of facts, it is difficult for us to foreshadow the consequences.

BILLS BEFORE PARLIAMENTARY COMMITTEES.

MUNICIPAL TRADING.

THE Joint Committee of the Houses of Lords and Commons appointed to inquire into the question of municipal trading, resumed its sittings on Friday last, the Earl of Crewe presiding.

The first witness, Mr. CHANDOS LEIGH, Q.C., counsel to the Speaker of the House of Commons, explained to the Committee the practice in regard to private Bills, their examination, and the means taken to prevent the introduction of clauses which might be objectionable in the interests of the public. The witness, in the course of his evidence, said he rather deprecated the practice of a municipality acquiring compulsorily a water or gas company against their will and without their consent. That was a practice which had increased enormously during the last few years, and now there were 250 local undertakings in Great Britain who held gas undertakings, and practically in all those cases the undertaking had been originally founded by a private company, and subsequently purchased by the local authority. Speaking broadly, one might say that the municipalities never invented or initiated anything with regard either to electricity, gas, or tramways, and yet when a private supply company got into flourishing circumstances, they had often been forced into a corner on the question of purchase.

Mr. SYDNEY MORSE said that he was the chairman of the Municipal Trading Committee of the London Chamber of Commerce, and he would like to take the general question, and to deal with it in detail as it arose. They had had discussions in the Council of the Chamber of Commerce on the question, and the Council in the Spring passed the following resolution:—"That the scope and sphere of municipal enterprise in opposition to and exclusive of private enterprise should be defined; and that with this object it is desirable that the whole question should be referred to a joint committee of both Houses of Parliament." Proceeding to deal with the Act creating corporations, he said that the Act of 1885 enacted in effect free trade as against the previous action on behalf of municipalities by which trade was prohibited excepting with their license.

The CHAIRMAN: You had something to say as to the Tramways Act, and particularly as to Clause 4 as to the consent of local authorities?—Yes; as regards consent. I have had a large experience in dealing with local authorities in these matters, and what I find is this—they do not consider the question as to whether the proposed tramways are desired by the public or not; they consider it from the point of view that their consent is made by the Act, a condition precedent to the grant of any powers, and it is for them, therefore, to hang conditions on to the fullest extent possible.

Continuing, WITNESS quoted instances to show that occasion was taken to "bleed the companies" with regard to granting this consent. The same thing had been done with regard to electric lighting.

The CHAIRMAN: As a matter of fact, applications are generally made by provisional order?—That is so; we have to prove consent of the Board of Trade, but although the Board of Trade have power to dispense with the consent of the local authority, until last year they had never used it in any case. It was the mere question of grant or no grant. What I have found occur is this: In the early days, when electric light was first being put forward as really an experimental matter, there was no difficulty in getting consent, because it was difficult to find anyone to take up the experiments, but as the matter has become more and more an assured success, it has been more difficult, and to get consents nowadays, if you go to the smallest districts in the country, you have very onerous terms put upon you as a condition for the consent. We also find, where the authority owns the gasworks, we frequently have this argument addressed to the Board of Trade—that the authority has invested a large sum of money in gas which might be endangered if electric light was to be brought in by a company, and that has prevailed.

In fact, you are making very much the same complaint with regard to electric light as you made with regard to tramways?—That is so; and I say this, that it has also very seriously retarded the progress of electric lighting, and many places have been for years without electric lighting because of this want of consent, where otherwise electric light might have been given. In other cases, local authorities have spent very large sums of money under circumstances in which it would have been unnecessary, because they might have taken a supply from an adjoining company, and also it has retarded the general engineering manufacturing science of the country.

Proceeding to deal with the question of purchase, WITNESS said that he had been a member of the Council of the Institution of Electrical Engineers, and he knew that the electrical industry felt that it had been placed on very unkind conditions as regarded thei

industries. Railway, gas, and water companies obtained a freehold in effect; they were limited in price and dividend upon a reasonable basis, but electrical undertakings had been limited both as to consent, price, and as to terms of purchase, and it had been, he supposed, quite as important an industry as any of the others. He did not wish to say it was impossible for municipalities to work a tramway fairly well, but they wanted to put the matter on a broad principle. It came to this, that it was a very important business, and it seemed to go without saying that it was impossible for new people without experience to manage a complicated business.

The CHAIRMAN: As regards veto; you say that the necessity of getting consent has greatly retarded the progress of tramways?—I think there is no question about it. I could quote order after order where mechanical powers had been given to a company, but prohibited until the company was able to get the consent of the local authority, and nowadays it is always prohibited on the ground that the local authority are anxious to work it themselves.

Continuing, WITNESS said it was quite clear that tramway companies had not had fair play. They were introducing a new business and had to embark their capital, and had to endeavour, if possible, to keep that capital intact and to make a living wage during the life of 21 years, at the end of which they were certain not to get back their original capital. They could not spend money in improving the property or in extensions. On the other hand, the municipality had a freehold, and could look to the future to repay or recoup losses arising from the expenditure of the moment. It stood almost to demonstration that with only 21 years of life it was almost impossible to make the undertaking successful, and the same thing applied with regard to electric light.

The Joint Committee sat again on Tuesday, when Mr. MORSE was further examined, and said, in reply to the CHAIRMAN, that the principle they wished to put before the Committee was, that the action of municipalities in trading should be restricted to undertakings in the public interest and not with a view to profit. Unless they got something in which every ratepayer was interested it was hardly fair that the risk should be undertaken where all did not get all possible advantages. Then he would point out the great importance of supervision over such matters in the public interest—such as tramways, and matters of that sort. Another objection to municipal trading was the danger of employing large numbers of workpeople who were voters. Glasgow were now employing a very great number of workpeople. In London it was stated that scavengers were promised at election times 25s. a week, and statements were made that by combination members of local bodies could be made the servants instead of the masters of workpeople.

Asked by the CHAIRMAN if it was really the case that the Board of Trade accepted as an objection to electric lighting that the Corporation owned the gasworks, WITNESS said they had lately had a case in Wales where an application was made for a provisional order and this argument prevailed. The only ground of objection was that the local authority owned the gasworks, and the Board of Trade decided not to grant the application.

Mr. GRANT LAWSON, M.P.: Did the Board of Trade decide that the argument was reasonable?—They simply said, "We do not grant the order."

Further, WITNESS said that with the municipality in possession there was no incentive to take advantage of any new invention.

The CHAIRMAN: What is the distinction you draw between water and gas or electric light?—It is essential from a sanitary point of view that every house should have a good supply of water, not only for the persons inhabiting that house, but also for the neighbourhood. But it makes no difference to Householder A whether Householder B has no light at all—it is not a matter affecting anyone but the particular person. If a person likes to use a lamp, why should he be compelled to supply his capital for gas or electric light?

But I should imagine that the municipalities would not say that they were running the tramways for profit?—But that is the whole of the argument. It is said: "Why should a profit made out of the public go into the hands of private companies?" That is the cry put forward everywhere in favour of municipal enterprise.

Continuing, WITNESS said that it was not fair that an individual should have to pay the sinking fund for a tramway in the way of a higher fare. But in principle he should say that a tramway was not a proper object for municipal ownership. As an instance, he would take London. The London County Council had a Bill before Parliament that day, but it was quite clear that a very large proportion of the people of London would never dream of using tramways, and therefore ought not to be rated for the purpose. His objection would be that it was not a matter of absolutely general user. Then with regard to the procedure of unopposed Bills, he suggested that the Committee should lay down some principle, so that matters of principle should not be altered without consideration in some more general manner than was possible by the officials of the House. He suggested that in the case of unopposed Bills, where there were alterations of principle, they should be referred to a Committee to see if there should be any alteration. It was true that there was power to send unopposed Bills to the Standing Committee, but he ventured to think the officials of the House would be rather glad if the necessity for doing this were strengthened. It was frequently put forward that local authorities only supplied in the public interest, but it was found that where local authorities supplied gas and electricity outside their own district, they generally charged more. Then if there was a provisional order granted to a company, there was a special clause requiring audit by the Board of Trade, but when an order was granted to a local authority, the clause as to audit did not apply. In the present year the London County Council introduced a Bill for street widening, and they also went before the Light Railway Commissioners for a scheme for light railways. They admitted that streets would require widening, and they were asked why they did not put clauses in the Bill for street widening, and they answered that they were promoting another Bill for street widening. The Light Railway Commissioners threw the scheme out, but if the scheme had been authorised, the street widenings would not have appeared in the capital account. On the other hand, a company would be compelled to put the whole down as capital expenditure. Then if a Town Council took in hand electric lighting, it did not put down the proper proportion of its whole administrative expenses to the new undertaking, but as was given in evidence in the Shoreditch case it put down only the additional cost incurred. He did not say that it was dishonest, but it did not allow of a fair comparison being made between the two sets of accounts. There was no doubt that giving local authorities power to compete in electric lighting and tramways, had undoubtedly retarded electric lighting and tramways in the country. Indeed, they were so far behind that they had to get a vast amount of their plant from America. He could show case after case where for many years local authorities had by merely refusing consent, prevented the supply of electrical energy in large districts.

Replying to Lord ROTHSCHILD, WITNESS said it was often found that local authorities obtained provisional orders for electric lighting which were not used. When, however, a company came with a scheme for tramways, the condition was made that the electric energy should be taken from the local authority.

BOURNEMOUTH TRAMWAYS.

A SELECT Committee of the House of Commons, presided over by Mr. W. H. Holland, on Tuesday heard an application of Mr. Pembroke Stephens, Q.C., on behalf of the Bournemouth Corporation in respect to the Tramways Bill. Before the recess the Committee considered the Bill of the Tramways Company to construct a tramway through the borough so as to connect their line from Christchurch to the borough on the one side and from Poole to the borough on the other side. The Corporation promoted a scheme for tramways for the borough, part of which scheme was to construct a line through the centre of the town. The tramways will be worked electrically. The Committee decided that the line should be constructed by the Corporation, but that the company should have running powers over it, and they also gave the Corporation similar running powers over the company's lines.

Mr. PEMBROKE STEPHENS now wished to reopen the matter, and argued that there were no precedents for giving running powers over municipal tramways. Cases had been mentioned, but he submitted that it was a complete mistake to say that any such powers had been granted.

Mr. MOON objected to the application, and said the agreement had been actually signed.

The CHAIRMAN said the Committee had considered the whole of the matter when it was first before the Committee, and the argument should have been put before the Committee then.

Mr. BALFOUR BROWNE, Q.C., said he opened his case on the merits of the scheme, and they had actually the agreement between the two agents. If they were to reopen the matter now it would be very bad for practice.

Mr. PEMBROKE STEPHENS said if he could not re-open the case now he should have to go to the other House and say that there had been a miscarriage of justice.

The CHAIRMAN said the Committee were advised that as a matter of order the Bill was not now before them, and so however disposed the Committee might have been to listen to the arguments of Mr. Pembroke Stephens they could not do so.

LANCASHIRE ELECTRIC POWER BILL.

THE Select Committee of the House of Commons considering the various Electric Power Bills referred to them, resumed their hearing of the evidence in the Lancashire Electric Bill on Monday.

The case of the Urban District Council having been closed, Mr. WILLIAMS opened the case for the Southport Corporation, who opposed, and took exception to Mr. Worsley Taylor's statement that the area proposed to be covered was all manufacturing. As a matter of fact, around Southport was a very large extent of agricultural land. The whole foundation of the promoters' case depended on them getting something from the Committee which had never been obtained by anyone before, and also getting something from the Board of Trade which had never been granted before. Then Mr. Gripper calculated that the company would have a load factor of 30 per cent., but in order to secure a load factor of 25 per cent., they would have to supply three times as much energy for power as they would for lighting. Apart, however, from these considerations, he pointed out that Southport was purely a health resort, and there was no demand in that town for the company. Further, he doubted altogether whether the promoters would get their capital, for no one had come forward who was prepared to embark capital in the undertaking.

The CHAIRMAN pointed out that if Southport did not take a supply there would be no reason to go through the town, and, therefore, Southport could not be injured.

Mr. WILLIAMS said that was so, and therefore he saw no reason why Southport should be in the Bill, because there never would be a requisition for the company to come in, as Southport could do much better for itself. Why the company wished to include Southport in the Bill was so that they could issue a prospectus which would stagger humanity. He admitted that the problem of the supply of cheap electric power remained to be solved, but contended that the true solution was in a combination of local authorities rather than by giving powers to a speculative company.

Mr. T. B. GRIFFITHS, Mayor of Southport, said he saw no possible

reason why the company should be given powers to come to Southport. In Southport they were generating electricity at a very cheap rate, and they were advised by their engineer that they could beat the company easily as regards the price.

Replying to the Chairman, Witness said he considered that the whole of Lancashire affected by the Bill would be injured, because there would be a company of traders with protective rights set up in their midst, and no one else could compete with them except by Bill in Parliament.

Mr. C. D. Taite, borough electrical engineer for Southport, said the Corporation had laid down a system of tramways to be worked by the overhead electric traction system. He believed that they could supply electric power at a cheaper rate than the promoting company, and therefore he saw not the slightest possibility of anyone going to the company.

By Mr. Worsley Taylor: The capacity of their works was 2,000 H.P. Except for tramways, there was no demand in Southport for power. For power they charged 6d. for the first hour and 2d. per hour afterwards.

Mr. Balfour Browne said he represented 13 boroughs in the area concerned, including Manchester, Liverpool, Bolton, Oldham, Accrington, &c. The whole of these boroughs concerned protested against the Bill. They all agreed that the value of electrical energy for power was amply demonstrated, but the object of the promoters was not to supply, but they had an ulterior object. In the scheme there would be no economy, because the area was too large. He ventured to say that the promoters could show no public advantage by being allowed to come in, and that was shown by the fact that every local authority of importance opposed the Bill. There seemed to be an idea that the large boroughs had not done all they should in the way of supplying electricity, but that was not the case in Manchester certainly, and Manchester was supplying all round the city. In the case of the Durham Bill there was a difference, because the local authorities were small and could not supply themselves, but in Lancashire the towns were large, and could, and did, supply themselves with electricity, and had, in fact, spent £2,136,000 in such supply. It was very doubtful whether the promises of the company could be carried out, because they would not get the diversity of load which they had in Manchester. With regard to large scale production, there was no doubt that up to a certain extent there was economy, but in the case of that scheme there was provision to form generating stations, which was with the purpose of laying a feeble hand on the district for some ulterior object. It was said that economy would result from the fact that the generating stations would be at the pit's mouth, but he pointed out that the cost of carrying a main to Clitheroe would be £45,000. He characterised the scheme as wild, ridiculous, and absurd.

Mr. Alderman Higginbottom, of Manchester, said the Lord Mayor of Manchester called a conference of local authorities concerned to consider the Bill. There was a large attendance, and a resolution was unanimously passed that the Bill should be opposed. The conference were strongly of opinion that the company should not be trusted with such sweeping powers. They felt that powers should not be given to the promoters to traverse the streets without local consent. He saw no advantages which would be given by the Bill which would outweigh the inconveniences. The 27 boroughs of Lancashire had expended already £2,136,000 on electrical undertakings, and had arranged to expend a further sum of £2,100,000. The Manchester Corporation had made arrangements by agreement with various local authorities to take over provisional orders, and these agreements had been approved by the Board of Trade.

On the Committee reassembling on Tuesday, Mr. Alfred Higginbottom continued his evidence. He said that the Corporation supplied an area of some 45 square miles, and he should put the limit of a practicable area at some 100 square miles. He agreed that the whole of the portion of the county affected by this Bill ought to have a chance of obtaining a supply of electricity at a cheap rate, and that a company ought not to take merely the richer part of a district, and leave out the poorer; but he did not think that by this Bill the company were under an obligation to supply the northern parts of the area within a reasonable time such as the municipalities would be under. As regarded the question of the interference with the streets, he should be satisfied with an appeal to the Board of Trade in the matter of the route, but he thought the municipality ought to have a control also, as to the kind of cable laid, and the manner in which the cable was laid. Another most important point was as to how the company proposed to deal with alterations and accidents. He believed the Corporation of Bury no longer opposed the Bill. Quite apart from the question of damage, the other municipalities were opposing the Bill because no public advantage would accrue from it. The company would be occupying space that would ultimately be required by the Corporation for their own purposes, and in return for which the Corporation would derive no benefit.

Replying to Mr. Freeman, Q.C., Witness said that if the cables were to go through their streets both those matters should be under their control, as Mr. Ritchie on the second reading promised they should be.

Replying to the Chairman, Witness said he calculated that the cost of working a 10-horse engine for 10 hours a day for 5 days a week for 50 weeks in the year, would be, according to the scale charged by the Corporation, about £130; that was 1½d. a unit.

Mr. Arthur B. Holmes, electrical engineer to the Corporation of Liverpool, the next witness, stated that, like the other Corporations represented in the Lancashire Conference, Liverpool was strongly opposed to the Bill, which would inflict great damage and inconvenience without conferring any public benefit. In his opinion, the calculations of the promoters were not sound. He saw no provision in the estimates for the cost of constructing transforming stations in the area of supply, or for the apparatus that would require to be fixed in these stations, and no provision for duplicating the mains. In his view, the proposed load factor of 35 per cent. was purely imaginary, and could not be attained in practice. His experience was that the company would have to depend for customers on the small consumers of power. Where compulsory powers were given to a company to lay mains he thought the local authority should have power to supervise the laying of the mains, and also a voice as to the construction of the main itself, the material, covering, and way of laying it.

In cross-examination, Witness said the promoters could not possibly give the Corporation proper protection, because the Corporation wanted all the room in the streets for themselves. He did not know of any street in which the room would not be required by Liverpool for its own purposes. The largest consumers of power in Liverpool were the printing establishments. The largest motor was 50 H.P. The expenditure for electrical purposes was approaching a million, and he thought that would suffice for the next two years, though in future this expenditure might be doubled. So far as this expenditure brought a proper return, and supplied a public want, he saw no reason why it should be limited. He was not afraid that the progress of improvement might lead to a large loss by plant becoming obsolete, as they were bound to write off in such a short period—25 years—that he could not contemplate any circumstances that would bring disaster. There would probably be a change in regard to lighting, the effect of which would be to cheapen the cost.

Further examined, the Witness said at present they supplied 800 H.P. of electricity for power. If they were called upon to supply the docks with mechanical power, it would amount to several thousand horse-power. At present they had 50 or 60 customers.

Mr. C. H. Wordingham, electrical engineer to the Corporation of Manchester, expressed the opinion that no economy would be got by increasing the scale on which electrical energy was produced, beyond about 20,000 or 30,000 H.P. The only saving which the company could hope to make was in the carriage of coal, and that saving would be altogether swamped by the high cost of the mains to the area of supply. He did not believe it was commercially practicable to carry electricity long distances in this country.

The Committee then adjourned.

Tramways at Rochdale.

A Select Committee of the House of Commons, presided over by Lord Edmond Fitzmaurice, on Monday considered the clauses in the Omnibus Bill of the Rochdale Corporation. A clause was approved authorising the Corporation to acquire the tramway in Halifax Road and make it suitable for electric traction, so that it might form part of a through system between Rochdale and Littleborough. By an agreement it was provided that at the end of 21 years the District Council should have the option of acquiring the tramway on the payment to the Corporation of the then value of the electrical equipment.

LEGAL.

The Electric Construction Company, Limited, *v.* The Imperial Tramways Company, Limited, and the British Thomson-Houston Company, Limited (Third Parties).

In the Court of Appeal on Thursday last week, before the Master of the Rolls and Lords Justices Rigby and Collins, the case of the Electric Construction Company, Limited, *v.* the Imperial Tramways Company, Limited, and the British Thomson-Houston Company, Limited (third parties), was heard on appeal by the plaintiffs from an order of Mr. Justice Cozens-Hardy, who had dismissed an action in which the plaintiffs, as assignees of a patent for improvement in motors for electric carriages, claimed damages against the defendants for infringement. Since the commencement of the proceedings the patent in question had expired, and the plaintiffs did not therefore proceed with their claim for an injunction. The defendants pleaded invalidity of the patent, on the ground of want of novelty, and relied upon a number of anticipations. The patent was one taken out by a Mr. Sprague, an American gentleman, and its object was to so arrange and support the motor, that the relative positions of its armature and field magnet would not be changed, and the mechanical connections between the armature and the driving axle would not be disturbed by any movement of the car body or carriage body on its springs, while at the same time the driving axle was relieved of dead weight. His Lordship in the Court below held that Claim 1 had no reference to a spring suspension, but applied to a case where the car body had no truck, and where springs were not described. It also applied to a case where there was a truck, but where belts were used, and where springs would not be needed. The second claim also, in his opinion, had no reference to spring suspension. With regard to the third claim, he held that it added something which was not found in the first claim, and constructing the specification as he did, he came to the conclusion that the patent could not be supported.

Mr. F. Moulton, Q.C., Mr. Bousfield, Q.C., and Mr. Gray appeared in support of the appeal, and Mr. Cripps, Q.C., Mr. Astbury, Q.C., and Mr. A. J. Walter were for the defendants.

Mr. Moulton, in opening the case, said that the action was brought for infringement of letters patent, No. 9,527 of 1885, but the patent having expired, the only question of course, was that of damages.

railways. They admitted that streets would require widening, and

Mr. T. B. GRIFFITHS, Mayor of Southport, said he saw no possible

The defence relied upon was solely invalidity; the infringement was admitted. The allegation of invalidity was based on the usual numerous objections, anticipation, and no subject matter being the chief ones. But the point on which the judge decided against the validity of the patent was one of construction—construction of one of the claims of the specification itself. That being so, he proposed to take their Lordships at once to the specification, because he should submit that the interpretation put upon it by the learned judge could not be sustained.

The MASTER OF THE ROLLS: Do you admit if the learned judge's construction of the impeached claim is right there was anticipation?

Mr. MOULTON: There is a later question, which arises in this way. We say the claim is so limited, that even upon the learned judge's construction there would not be anticipation. The learned counsel said that in order to assist their Lordships to understand the specification he would shortly explain what the nature of the invention was. The invention applied to the question of how to mount an electric motor on the car which it drove. Of course the first peculiarity of an electric motor was that it was purely rotatory, and the next was that many parts of it must be exceedingly massive. It was a machine which ought not to be subjected to violent jolts because the work was very delicate, in order to contain perfect insulation of the wire both on the fixed part and the moving part. The only part of a motor which moved was the armature, which rotated inside the field magnets. In order to have effectiveness it must revolve quite close to the field magnets, because the intensity of magnetism diminished very rapidly as the surface of the magnets was left. It was absolutely essential that the motor should be absolutely fixed in its place. The bearings could not be allowed to move at all relatively to the motor, and the motor must not be subjected to shocks. The idea of using motors for cars was first started in 1880, or even earlier. He thought the Master of the Rolls would remember seeing in the Exhibition in 1881 at Paris a car by Siemens driven by a motor. Several methods of mounting the motor on the car were tried, and in 1885 the present inventor, a man named Sprague, a celebrated American inventor, invented this method, which now in the vast stride of electric traction had become the universal one. What the inventor did was this: he sleeved the field magnets of the motor on one of the axles and supported the other end by means of springs. The consequence of that was that by sleeving one end if there was a jolt on the wheel it was not a dead jolt of the whole of the weight of the motor, as it would have been if the centre of gravity of the motor had been above the wheel. This had the effect of causing a kind of rotation, which would take off a great deal of the severe jolt, and the movement of the truck only communicated itself to the motor through the supporting springs. The two features of the invention were sleeving of one end on to an axle, and having spring supports at the other end. This enabled the inventor not only to avoid jolts, but also to reduce the speed of rotation from the motor to the wheel. Effective motors, unless they were very big, moved rapidly, having a large number of revolutions a minute. It was not practicable to make the wheel of the car go as fast as that. It was necessary to gear down until several revolutions of the motor corresponded to one revolution of the wheel. The sleeving at one end made the gearing accurate in spite of the jolts. One thing was that no jolting would throw your gear out of gear, and the other was that the jolts were very much diminished. That was the nature of the invention. Having referred to the specification, Mr. Moulton said he should confidently submit that one thing was clear—that this was a spring-supported motor characterised by being sleeved upon a driving axle and having one or two sets of springs, which carried it either with the truck or with the carriage body, if there was no truck. That was the invention which they were prepared to defend, and which they insisted was the invention described. Now the learned judge in the Court below had taken what he should contend was quite a wrong view of the case. Taking that part of the specification which said "D is the field magnet of an electro-dynamic motor, and E the armature thereof. The yoke or back piece of the field magnet is hung from a cross-piece of the truck by heavy springs, or from the car body itself in case of a street car or other vehicle having no truck," the learned judge had found that that meant was not hung by springs in the case of a car which had no truck. He (learned counsel) failed to see absolutely any justification in the language of the specification for such a view as that.

The MASTER OF THE ROLLS: You say springs are essential in both cases?

Mr. MOULTON: Certainly; that was the whole spirit of the invention. He must say there was a disputed interpretation of claim, one as to whether it included springs or not. The claim was for "the motor of an electric railway car or carriage having its field magnet centred or sleeved upon a driving axle, its armature supported directly upon the said field magnet, and having a shaft separate from the driving axle and gearing, communicating motion from the armature shaft to the driving axle, substantially as hereinbefore described." But reading the specification from beginning to end, it was plain that the inventor relied upon springs.

The MASTER OF THE ROLLS: Your point is that springs are essential, and that the only thing optional are relieving or supporting springs.

Mr. MOULTON said that was so, but the learned judge had said that was not so. That where there was a car body and no truck there was suspension without springs. But really the truck and the car body without the truck were mechanically the same. The car body might not be called a truck, but it was the same thing.

Lord Justice RIGBY: It is rather peculiar that the inventor never uses the word spring in connection with the car body.

Mr. MOULTON: Oh, yes, he does. He says, "These springs extend to cross bars on the truck frame, or to the car body in case no truck is used." The "or" is "or" to, and not "or" by. There is no possible conceivable reason why he should not have spring suspension in both cases, and it is only a too abundant caution that makes him refer as a practical man to the case of a car body without a truck.

Lord Justice RIGBY: I think the meaning might have been made more clear by a little alteration of the language of the specification.

Mr. MOULTON: The claims, I shall submit, describe nothing but a spring attachment. The second claim brings in the relieving or optional spring, and I do not think I need trouble much about that.

The MASTER OF THE ROLLS: The serious question seems to be Claims 1 and 3.

Mr. MOULTON said that with regard to Claim 1, although no express mention was made of it, it implied spring supports.

Lord Justice RIGBY: What is the difference between Claims 1 and 3.

Mr. MOULTON: The difference is twofold. In the first place, Claim 1 is limited by the phrase having the armature directly supported on the field magnets. Then there was a difference in the point of view. Claim 3 is drafted in a totally different way to 1 and 2. 1 and 2 goes through the specification, but Claim 3 seizes the spirit of the thing. I don't want to get off the safe ground of what my invention is. I say my invention never contemplated anything but spring suspension, and that is reiterated all through the specification. The whole connection is through springs. I daresay that the claims might cover a good deal of latitude as to the way in which the springs are to be applied, but it would not include cases where the motor was bolted to the truck or the car body. That was never contemplated, and, indeed, it was the whole aim of the inventors to obviate that. I quite agree with the learned judge that Claim No. 2 is Claim No. 1, plus the optional springs, but both imply the spring supports or the equivalent to spring supports.

Lord Justice RIGBY: What would be the equivalent to spring supports?

Mr. MOULTON: I don't know of any equivalent. A case had been suggested of a motor suspended by links to something having springs on either side, but that *de facto* would, of course, be spring supported. The only question really is, however, whether the inventor meant to tell the public that he claims fixing the motor by any other method than that of springs.

The MASTER OF THE ROLLS: We shall have to consider whether he has warned the public off a wider field in his own interests.

Mr. MOULTON: If spring suspension had been in Claims 1 and 2, the inventor would still have added Claim 3, because it is a wider claim.

The MASTER OF THE ROLLS: I must say I do not think on looking into it that Claim 2 refers only to relieving springs, and if that is so, it is seriously against you.

Mr. MOULTON: I shall submit that refers to relieving springs only. Else of what value would be "substantially as hereinbefore described?"

The MASTER OF THE ROLLS: How words cover a multitude of sins.

Mr. MOULTON: It is not necessary to read in the words spring supports, if it is understood, as anyone would understand it that the spring connections with the truck is essential.

The hearing was adjourned.

MONDAY, JUNE 18TH.

Mr. BOUSFIELD, following Mr. Fletcher Moulton, said that apart from the question of the springs, the sleeving mentioned in the specification was of great importance. The whole object of the invention was the mode of attachment of the motor, so that the up and down movement of the car should not harm it. To get that it was necessary to have one end sleeved on to the axle. Nobody could fail to see that the purpose of sleeving at one end was to allow freedom of motion at the other end. The sleeves described in Claim 1 meant sleeves to permit of the kind of motion.

The MASTER OF THE ROLLS: In his judgment Mr. Justice Cozens-Hardy had used these words, "This being the construction which I place upon the specification it was faintly, if at all, argued that the patent could be supported," but what I want to know is this, if we should be of opinion that the first claim does not include springs or their equivalent, but was independent of the mode of attachment, do you agree that the action proceeded in the Court below on the basis that the patent could not be supported?

Mr. BOUSFIELD said he could not accept that view.

The MASTER OF THE ROLLS: You still say that the patent can be supported, although the first claim has nothing to do with springs?

Mr. BOUSFIELD said it was true the whole fight was conducted on the assumption that the first claim implied springs, but when they were met by an alternative which did not include springs, then it was clearly put that even in that case it was not anticipated. The fact that the learned judge used the words "faintly argued" positively showed that the alternative was put before him, and one judgment having gone against them, they were now more anxious to make good before their Lordships their contention as to that alternative.

Lord Justice RIGBY: Your own witnesses say that springs are essential, and that if Claim 1 did not include springs, the other four things are not within the invention.

Mr. CRIPPS: That is how we put our case.

Mr. BOUSFIELD: Then I am entitled to complain that my learned friend did not bring it home rather more closely to the witnesses. I do not, however, intend to argue that springs, or what would amount to an equivalent, are not essential to our invention.

The Master of the Rolls: The difficulty seems to be that, apart from Sprague, there is nothing to show that it may not have been thought perfectly good to support the motor so that the relative positions of the armature and the field magnets would not be changed, and the mechanical connection between the motor and the driving axle would not be disturbed.

Mr. Bousfield said the inventor had got a problem before him. He stated in the specification the nature of the problem, and then he explained how he was going to solve it.

The Master of the Rolls: You have got to state what your specification means.

Mr. Bousfield remarked that the specification was a plain statement of the object of the invention, and they must take the claim in connection with what was the real purpose of the invention. They must be read in conjunction with what had gone before in the specification. He admitted frankly that he had to argue this first claim on the supposition that it was a claim for a particular combination used in a manner inconsistent with the use which the patentee proposed to make of it. He could not hope to succeed, because it was not only anticipated by Sprague but by half a dozen other people, but if he took the claim as a combination to be used so as to effect the purpose of the patentee, and which was consistent with the description which went before it, then he felt that his difficulties, if they did not vanish, were, at any rate, very much lessened.

The Master of the Rolls asked Mr. Cripps to direct the attention of the Court to that part of the evidence which bore upon how the case was conducted in the Court below.

Mr. Cripps said that in the Court below, quite outside Sprague or any anticipation of any kind, the witnesses called by the plaintiffs themselves assented to the proposition that apart from the springs there was no invention at all. The learned judge upon that held that the first claim excluded the springs, and, therefore, as he said, it was faintly, if at all, argued that the specification could be supported. Mr. Moulton in the Court below took his stand on Claim 3, which included springs, and endeavoured to show that in the light of the claim, springs could be read with Claim 1.

The Master of the Rolls: That was their main argument here.

Mr. Cripps then read those parts of the evidence directed to his argument that if springs could not be read into Claim 1, there was no invention.

Mr. Moulton shortly replied.

The Master of the Rolls, in giving judgment, said that this was an appeal from the judgment of Mr. Justice Ozens-Hardy, who had decided upon the construction he had put on the first claim to certain letters patent that the patent could not be supported. Speaking for himself, he (the Master of the Rolls) felt very considerable sympathy with the patentee, because this was a case not without precedent in which the real substantial anticipation was a disclosure of the patentee's own invention in a description previously sent from the United States of America by the inventor and communicated to Great Britain. But if they came to the conclusion, as in his judgment they were driven to do, that the claim in the specification so long as it stood was too wide and was old, they had no alternative but to accept the position described by Mr. Justice Ozens-Hardy that the whole patent was invalid. The patent related to the means of connecting electric motors with the wheels which they were to drive. It was to be observed—and he thought it was a very important matter in the present case—that the Court had no statement made to it as to what the existing state of knowledge was, which they had to bear in mind in construing the claim in the specification. All the Court had to judge it was the nature of the specification itself. Now, the object of the invention was stated in the opening passage of the complete specification:—"This invention relates to electric motors mounted upon railway cars or carriages for the purpose of propelling the same, and its object is to so arrange and support the motor that the relative positions of its armature and field magnet will not be changed, and the mechanical connections between the armature and the driving axle will not be disturbed by any movement of the car body or carriage body on its springs, while at the same time the driving axle is relieved of dead weight. In accomplishing those objects, the yoke, or back piece of the field magnet of the motor, is hung from a cross-piece of the truck of the car or carriage by heavy springs, or from the car body itself in case of a street car or other vehicle having no truck." The next few paragraphs of the specification described certain proportionate parts of the invention. He passed now to observe that it had been contended on behalf of the appellants that the Court was to assume, for the purpose of construing the specification, that the whole, and if not the whole, the real substantial merit of the invention rested on the fact that the motor was suspended by springs from the car, and that the Court was to assume both from the directions given by the patentee in his specification, and from such reasoning as their Lordships could bring to bear upon it themselves, that it would be utterly inconsistent with any application of the invention that the motor should be suspended by anything other than springs or their equivalent. Speaking for himself, he (the Master of the Rolls) did not think there was anything on the face of the specification which enabled anyone to form that conclusion. His Lordship then referred to Claim 1 of the specification:—"The motor of an electric railway car or carriage having its field magnet centred or sleeved upon a driving axle, its armature supported directly upon the said field magnet, and having a shaft separate from the driving axle and gearing communicating motion from the armature shaft to the driving axle, substantially as hereinbefore described." That first claim enumerated what appeared to be the essence of the invention, excluding the springs in terms. It had no reference to a spring suspension. Then it was said that the Court, by reason of the words "substantially as hereinbefore described," must read into Claim 1 the supporting springs. He thought that would be a construction the Court had no right to adopt. His Lordship had read the whole of the proceedings in the Court below, and looked through the whole of Mr. Moulton's speech, and from the way the cross-examination was conducted, he could not see any substantial indication that the plaintiffs in the Court below attempted to justify the first claim, if it were assumed that the springs were not included in it. He thought, in the present case, on the face of the specification, that the Court must come to the conclusion that the patentee whatever he wanted to do did claim as against the public to include as within the ambit of his invention a claim to a motor in which the field magnet was centred or sleeved upon a driving axle, its armature supported directly upon the said field magnet, and having a shaft separate from the driving axle and gearing communicating motion from the armature shaft to the driving axle, and this whether it was supported by springs or not. That being so, on the evidence given in the Court below, he came to the conclusion that it was impossible to say that that particular combination excluding those springs was new. He thought himself it was clearly shown in the drawings of the Sprague invention, and so shown that any competent electrician could have understood it at once. Here no witness had said that those drawings would not have disclosed to a competent electrician the four essential features of the first claim. That was published in England before the date of the application for a patent, and that being so it was not possible to support the first claim. For those reasons he thought that Mr. Justice Ozens-Hardy was right, and that the appeal should be dismissed.

The Lords Justices gave judgment to the same effect, and the appeal was accordingly dismissed with costs.

The National Telephone Company *v.* the Tunbridge Wells Corporation.

This case came before a Divisional Court of Queen's Bench, composed of Justices Grantham and Channell, on Monday, and raised the question as to whether a stipendiary magistrate or a County Court judge has since the Telegraph Act of 1892 any jurisdiction to hear and determine an appeal from a refusal of the highway authority to allow a telephone company to open up streets for the purpose of laying wires or tubes. It appeared that by two deeds, the first dated in 1884 and the later in 1896, and made between the Postmaster-General and the National Telephone Company, the company were authorised to work and use certain forms of telegraph for the purpose of transmitting telegrams within the borough of Tunbridge Wells. By a deed dated March 10th, 1896, and made between the Corporation and the Telephone Company, the Corporation consented to the company, subject to the provisions of the agreement, exercising within the borough such powers as might from time to time, and at any time, be delegated by the Postmaster-General to the company in pursuance of the provisions of Section 5 of the Telegraph Act, 1892. This deed went on to say: "It is expressly agreed that the consent contained in the preceding clause is given upon the following conditions: (1) Except as regards the work mentioned in the schedule, the company shall not exercise any of the powers conferred on the Postmaster-General by the Telegraph Acts, 1863 and 1878, in respect of which the consent of the Corporation is required under the said Acts, without obtaining the further consent in writing of the Corporation to be from time to time given to the specific works for the time being proposed to be carried out under such powers, it being intended that the general consent contained in the preceding clause is not to operate to relieve the company from the obligations of obtaining the particular consent of the Corporation to such specific work as required by and provided for in the said Acts." Clause 10 of this agreement contained a reference of all disputes under its terms to two arbitrators and an umpire. The company wished to open a street and lay telephone wires, and to execute works not mentioned in the schedule to the last mentioned deed, and applied for the consent of the Corporation. The Corporation refused, and the company contended that under Section 4 of the Telegraph Act, 1878, they had the right to refer the "difference" to the County Court judge. The County Court judge while expressing the opinion that he had jurisdiction to hear, and determine the difference, refrained from doing so until the hearing of this motion which was for a prohibition upon the ground that since the Telephone Act, 1892, Section 5, the County Court judge had no further jurisdiction in such cases.

Mr. Joseph Walton, Q.C., Mr. Macmorran, Q.C., and Mr. Boxall appeared for the Corporation, and Mr. Cripps, Q.C., and Mr. Cassell for the company. Mr. Walton having read the special case stated by the learned County Court judge,

The Court called on Mr. Cripps and Mr. Cassell for the company, who submitted that the effect of the deed of March 10th, 1896, was that for all works other than those specified in the schedule, the consent of the Corporation "as required by the said Acts" was needed. That meant the consent subject to appeal to the County Court judge. They further contended that the County Court judge was constituted an arbitrator, and that prohibition was not the appropriate remedy.

Mr. Justice Grantham said there was no doubt what their judgment should be. The National Telephone Company had not brought themselves within the Act of Parliament, which gave general powers to carry on these works in the way in which it had been claimed for by the National Telephone Company. There was not much doubt as to what really was the history of this legislation. In 1878 everything was in the hands of the Crown and the Postmaster-General. Then pressure was brought to bear upon them, and they consented to delegate some of their powers, but the moment they did that and allowed these works to be carried out by a company they very properly changed their *modus operandi*. During the time that it was a Crown monopoly and the Crown had a right to do this work it was considered

just that the judicial authorities of the Crown should be invoked to determine any difference that arose between the Crown and the public authorities. The Postmaster-General consented to do this work in Tunbridge Wells. By Act of Parliament it was provided that, supposing there was a difference between the Postmaster-General and the authorities at Tunbridge Wells, some tribunal must determine who was right. It became a question of the right of the Crown to do this, and the legislature decided to invoke the aid of the judicial authorities of the Crown—the County Court judge or stipendiary magistrate. Then came the Act of 1892, whereby these powers were delegated. The moment private individuals carried on this work, the right which the Crown had to call in the aid of the judicial authorities ceased, and more power was given to the authorities in whose district the work was to be done. The urban authorities were given a power of veto. Their consent must be obtained to the exercise, first, of the power to be delegated, and then there was a right to say in what way they would consent to these powers being exercised. The Tunbridge Wells authorities gave a general consent, but subject to the general terms of the agreement, that the consent was only to do the work thereby agreed upon and set out in the schedule, and before any other work was done they must obtain the further consent of the local authority. The parties to the agreement rightly understood what their rights and liabilities were. Under the Act of 1892 this agreement was expressly and properly drawn to give such rights as the Corporation intended to give, in the first instance to the National Telephone Company, reserving to themselves the right which, by the Act of 1892, they had power to reserve. The National Telephone Company was bound by the terms of the agreement, and had no right to say the County Court judge was the proper tribunal to determine any difference which had arisen between the parties.

Mr. Justice CHANNELL concurred, and the application was allowed with costs.

HUDDERSFIELD CORPORATION *v.* THE NATIONAL TELEPHONE COMPANY.

THIS case came before the Queen's Bench Divisional Court on Wednesday.

Mr. M'MORRAN, Q.C., on behalf of the Huddersfield Corporation, said it was an application for a writ of prohibition to the County Court judge of Huddersfield prohibiting him from hearing an application which had been made to him by the National Telephone Company under the provisions of the Telegraph Act, 1878. The agreement between the parties appeared to be the same as in the Tunbridge Wells case, in which their Lordships had found in favour of the contention of the local authority.

Mr. CRIPPS, Q.C., M.P., for the National Telephone Company, submitted that the agreement differed in three particulars. There was no arbitration clause, there was no power of veto on the part of the private owners, and there was no obligation at all to obtain the particular consent which their Lordships held was a particular consent without a power of appeal to the County Court judge and the railway commissioners.

Mr. Justice CHANNELL remarked that the difference between the two cases was that this was much stronger against the Telephone Company.

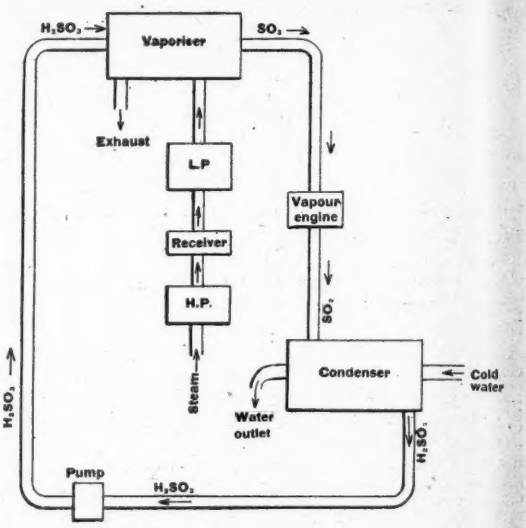
The prohibition was allowed with costs.

THE EFFICIENCY OF THE STEAM ENGINE.

BY ED. C. DE SEGUNDO, A.M.Inst.C.E.

THE steam engine and boiler have been brought to a degree of efficiency upon which there appears to be little room for improvement. There are authentic cases of boilers in which 85 per cent. of the heat energy of the coal consumed reappears in the steam raised. The Carnot efficiency of the steam engine itself has been brought to nearly 28 per cent., and the mechanical efficiency to 95 per cent. It may fairly be assumed that steam pumping plant can now be designed which will work at an absolute efficiency of $0{\cdot}85 \times 0{\cdot}23 \times 0\,90 = 17{\cdot}6$ per cent., that is to say, that 17·6 per cent. of the heat value of the fuel will reappear as available mechanical work done by the engine. At first sight this does not appear to be a brilliant result, though, when analysed, it will be found difficult to improve upon in the present state of our knowledge. The main source of wasted energy is, of course, in the loss of the latent heat of vaporisation of water. Although 966 thermal units must be expended in converting a pound of water into a pound of steam at atmospheric pressure and 212° F., this heat is lost as far as conversion into mechanical energy is concerned. It is the price Nature makes one pay for the privilege of being able to convert water into steam, and so utilise its expansive characteristics, and so far every effort to turn this 966 thermal units per pound of steam to account has failed.

The question that naturally rises to one's mind then, is whether it would not be more practical to use steam gas, and not saturated steam for the purpose of the steam engine. Unfortunately, however, Nature has got some very good reason why this should not be carried out practically, and the price that she exacts for using steam as a gas is even higher than before. Steam engine builders have attempted to meet Nature half-way by superheating steam to some extent on its way from the boiler to the engine, and very marked economy has been attained in this way, but nothing like the saving that would be effected if the latent heat of vaporisation could be utilised. An interesting attempt to convert the latent heat of vaporisation into mechanical energy has been made by G. Behrend, of Hamburg, and Dr. Zimmermann, of Ludwigshafen, who have jointly worked out the details of an engine, the general arrangement of which is shown in diagram in fig. 1. The engine was described by Prof. Josse at the recent centennial anniversary of the Royal technical school at Charlottenburg. It is a compound engine indicating 34 H.P. with a consumption of steam of 18·96 lbs per I.H.P. per hour. The steam from the low pressure cylinder passes into a vaporiser which



is practically a surface condenser, in which H_2SO_3 in passing through the tubes is converted into SO_2 by the heat of the exhaust steam from the low pressure cylinder circulating round the tubes. The SO_2 then passes to the auxiliary engine, as indicated by the arrow, where it does work, and then flows to the condenser, where the SO_2 becomes H_2SO_3 by contact with the cooled surfaces of the tubes. Thence the H_2SO_3 is pumped back to the vaporiser.

The auxiliary engine, in the combination referred to by Prof. Josse, indicated 19 H.P., being an increase of horse-power *per pound of steam consumed* of 56 per cent. In other words, 18·96 lbs. of steam per hour would now correspond to 1·56 H.P., or 12·13 lbs. steam per I.H.P.-hour.

Experiments showed that for every 33 169 lbs. of steam passing through the main engine, 1 H.P. was developed in the auxiliary engine.

If the temperatures between which the SO_2 vapour works be 140° F. and 67° F., the pressure would be between 147 lbs. per square inch, and 34·5 lbs. per square inch, hence pressures equal to boiler pressures are readily obtainable.

The Carnot efficiency would be about 26 per cent., that is to say, the engine would theoretically be capable of turning 26 per cent. of the heat supplied to it into work. As it yielded 1 I.H.P. for one hour, for 12·13 lbs. of steam, it turned into work nearly 18 per cent. of the heat supplied hence, the relative efficiency of the combination, roughly estimated, would be $\frac{18 \times 100}{26}$ = nearly 70 per cent.

This is not so good a result as that obtained from a quadruple expansion pumping engine set up at a station of the Pennsylvania Water Company, near Pittsburg, and which

was tested by Prof. Thurston in September, 1898. The efficiency of this engine measured against the perfect engine of Carnot was 84 per cent.

In this latter case the increase of efficiency was obtained mainly by the elaborate system of feed water heating introduced, and while, no doubt, applicable with success to a slow-speed engine such as the one referred to, it is not likely that the principle could be successfully carried out in connection with steam engines of the ordinary commercial type, or with high-speed engines. The suggestion of an SO_2 vapour auxiliary engine is therefore interesting, in that it effects what all attempts at increasing the efficiency of the steam engine aim at, namely, an increase in the range of temperature through which the working fluid passes by lowering the lower temperature.

As far as can be gathered, this SO_2 auxiliary engine has not yet taken a practical form. Possibly trouble may be experienced by the formation of H_2SO_4 during the cycle, which would, of course, be disastrous. Possibly, also, the extra space required, and the necessary duplication of all the essential parts of a steam engine, have been found to introduce more complication and involve greater disadvantages than are counterbalanced by the increase of power obtained.

CORRESPONDENCE.

The Towns' Refuse Problem.

I have to thank you for your fairness in inserting my comments on your article entitled "The Towns' Refuse Problem."

The pressure recorder diagram for November 7th, 1899, may be taken as fairly representing what is being done every day.

You say that Darwen is to be congratulated upon the character of the refuse it produces; now, as a matter of fact, the refuse at Darwen is rather below the average.

You still seem to lay great stress upon the fact that the quality of refuse must be very much lower during the summer months, but although the Darwen plant has not yet been working throughout June, July and August, yet there are other installations where the power is being used to a very large extent, that have been working for two or three years. I have one instance in mind, Hereford; there they manage to steam just as well throughout the summer months as during the winter months.

If you did not suggest that refuse was incapable of producing heat when burned, you certainly did appear to suggest that the available heat was a very negligible quantity, so insignificant, in fact, that it had never been used for any other purpose but for producing steam for grinding clinker.

The quantity of refuse dealt with at Darwen is about 40 tons per 24 hours, with one-half of the plant in operation only. The load is 200 amperes at 500 volts, the engines being of the Belliss type and requiring steam at 160 lbs. pressure.

I did not touch upon what you call "the vital point in your argument," namely, whether the refuse is completely consumed and the issuing gases rendered absolutely innocuous, for the simple reason that I thought it would be understood that with a modern high temperature destructor this would be done without any mistake whatever, the production of steam, of course, being a secondary consideration; but it is well to bear in mind that in cases where refuse is burned at a very high temperature of combustion and at a high rate of combustion—providing that the refuse is of average quality and that the cells are properly designed—there can be no possible question as to whether or not the efficiency of the destructor, as a destructor, must necessarily make it efficient as a steam raiser.

The only reason I laid stress upon the fact that a steady steam pressure was kept was because this is essential for electric lighting, and because it had been inferred by you that a refuse destructor had not yet done satisfactory work in conjunction with an electric lighting scheme.

In fact, this is one of the most often heard arguments against the employment of a refuse destructor in connection with an electric light station. It has been urged again and again that it is simply impossible to maintain anything like a steady steam pressure when refuse alone is the fuel used.

Many years ago, when it first dawned upon those interested to raise steam from destructor cells, one or two installations were erected where the boilers were put immediately over the top of the fire, much in the same way that the domestic kettle is pushed down among the coal. In this way a considerable amount of steam was raised, but not at a high temperature of combustion, and with so much cooling surface immediately on top of the fire, the primary object of the destructor was thwarted altogether. In fact, it could in no sense be called a destructor, but simply a refuse cooking apparatus combined with a steam raiser.

Surely, sir, you are not so little in touch with the times as not to know that a happy medium has now been reached, in some cases at any rate, and that it has been proved that a boiler can be placed in such a position as in no way to interfere with the efficiency of the destructor, as a destructor, and yet to absorb a considerable quantity of heat from the gases, at a very high temperature.

Knowing what a keen and searching interest you have taken in the destructor question for many years past, I thought I would like to put the foregoing remarks before you.

The conclusion of your article certainly appeared to me to be pessimistic, and you seem to strike a very hopeless chord throughout.

Personally, I am of opinion that refuse destructors are likely to be very largely adopted in connection with power schemes, not only for lighting, but for traction, and slowly but surely some of our best consulting engineers are coming to see the possibilities of the up-to-date high temperature destructor as a cheap power producer.

Incineratus.

66, Victoria Street, Westminster, S.W.,
June 15th, 1900.

I am much indebted to Mr. Goodrich for the kindly admonition which he repeats three times in the course of his letter appearing in your issue of to-day's date.

In the concluding paragraph of his letter, Mr. Goodrich cites four instances of refuse plants which yield "indicated horse-power per hour."

Many curious claims have been made for towns' refuse as a fuel, but if a constant consumption of refuse can be made to produce foot-pounds of work at an accelerated rate, Mr. Goodrich's encomiums err on the side of modesty.

Perhaps, though, Mr. Goodrich does not appreciate the difference between *work* and *rate of doing work*, but can it be possible, for one who tenders such good advice, to be at fault upon so rudimentary a point?

The Writer of the Article.

London, *June 15th*, 1900.

I have read with considerable interest the letter of Mr. W. Francis Goodrich, dated June 8th, on the above subject, with particular reference to Darwen, and your editorial comments thereon.

I think that, as one having intimate connection with that destructor, I may be allowed to answer a few of the criticisms.

The figures given by Mr. Goodrich are for the most part correct; the maximum load reached has been 250 I.H.P., but the average maximum for the winter lighting has been from 160—180 I.H.P. This, of course, is not a great load, but as we have been working non-condensing, the steam used per I.H.P. has been excessive, and will serve for a greater output, when we have fixed condensers to the engines, as is intended.

We have had from 30—35 tons of refuse to deal with per day, and as our only use for the steam has been during lighting hours, we have been able to use only a small proportion of the power available, much annoyance being caused during the daytime by the blowing off of our surplus steam.

The composition of our refuse has not as yet materially altered, a casual examination revealing a good percentage of carbonaceous matter. Nor has the quantity of refuse available fallen considerably; there is only a difference of 25 tons

per week as between the last two weeks and two weeks during last December.

I quite agree with Mr. Goodrich that there is such a thing as "average" refuse. Two 48-hour tests, taken one in August, 1899, and one at the end of last April, gave us the following results :—

	From and at
August, 1899, lbs. of water evaporated per pound of refuse,	1·55 lbs.
April, 1900, " " "	1·79 "

I consider that these figures are sufficiently near to justify the term "average" refuse, and also the use of refuse as a fuel for steam raising.

I must most emphatically protest against your statement "that efficient burning (*i.e.*, the complete combustion both of the material refuse and the noxious gases) cannot go on harmoniously and consistently with a steadily maintained steam pressure."

The Darwen destructor is hand-fired, and the draught is provided by Messrs. Meldrum's blowers.

We have found that the greatest efficiency has been obtained with a steady draught, the valves have been set, and the firemen have been instructed accordingly. With this draught, which is not nearly the capacity of the blowers, we are able to entirely consume our refuse, and at the same time to keep a steady steam pressure; and, to my mind, there is no reason why the two should not follow in ordinary sequence, any more than that the maintenance of the steam in a coal-fired Lancashire or other type boiler should be derogatory to the efficient consumption of the coal.

The firing is regulated according to the demand on the boiler—only one is used at once, a Lancashire, 30 feet × 8 feet, and the clinker, when examined, reveals no particles of unburnt combustible material.

Stanley Clegg, *Borough Electrical Engineer.*

The Electricity Works, Darwen.
June 19th, 1900.

Magnetic Field of the Earth.

It is now some years since I have been able to show the possibility of determining the true meridian of the earth by observations made in its magnetic field. While these experiments and instruments have been seen by a number of people, they do not appear to be convinced of them, owing, I believe, to the apparent want of a logical connection between these results and the accepted theory of magnetism.

I shall be glad, therefore, if you will permit the theoretical side of the question to be discussed in your columns, as it is a matter of interest to the electrician from the fact that it may lead to the determination of a universal and absolute standard of electrical quantities. Such standard we have, of course, theoretically, but experimentally there is considerable divergence of results.

The question which, I think, naturally arises in the minds of those who have seen the observations made by my instruments, is this. What possible connection can exist between the magnetic field of the earth and any *constant* direction on its surface? We know the magnetic meridian varies in every locality, and that it is also subject to displacement by local attraction. What possible factor can be found which will reduce all the angular differences of the horizontal components in the earth's field to one common direction? Is there any line on the surface of the earth which has a constant direction relative to the axis of rotation and to which these different angular values may be referred and measured by magnetic observation only?

I will try and put the answer to these questions, which I have arrived at after considerable attention, in the shortest possible form.

The neutral planes of every magnetic field contain the axis and moment of the mass which is magnetised.

Now the axis and moment of the mass of the globe are its polar and equatorial diameters. If, therefore, we can determine the direction of the neutral planes in the earth's magnetic field by the use of magnets only, we determine at the same time the horizontal direction of the lines contained in these planes, and consequently the horizontal directions of polar and equatorial diameters, in the locality of observation.

In this letter space will not allow the discussion of irregular magnetisation, though I believe that point can be elucidated also. But in support of the theorem that the neutral planes of a magnetic field contain the axis and moment of mass, we may instance the familiar example of the dip-needle. The axis of that needle, when unmagnetised, lies in a plane vertical to the points of suspension; while the moment of the same mass cuts the centre of this plane, and is vertical to it. After magnetisation, the contrary magnetic forces—the blue and the red polarities—meet and counterbalance one another in the plane containing the points of suspension. Then also the moment of the needle becomes the axis round which the circulation of the currents takes place which, according to Ampere, constitute a magnetic field.

The field of the dip-needle is, therefore, sub-divided by two planes which contain the axis and moment of mass, and applying the same law to the earth and its field, we may expect to find that the neutral planes of terrestrial magnetism contain the axis and moment of the earth's mass.

I have shown experimentally that those neutral planes in the earth's field may be found magnetically, and also that their direction approximates within a few minutes of arc to that of the polar and equatorial diameters.

I shall be glad to have the matter discussed.

Arthur W. Horsbrugh.

Electrical Engineering in the Navy.

With reference to the correspondence which has been printed in your recent issues with regard to the navy and electricity, I should be glad if you would find space in your columns for a few remarks on the subject from another point of view.

It is hard to imagine what reasons those at the Admiralty have for keeping down the efficiency of all electrical work in our navy by neglecting to employ men who understand electrical engineering.

Some information showing how electrical work is carried on may be of interest.

The charge and responsibility of electrical appliances in H.M.'s ships is divided between two branches, namely, the engineering and executive branches: the engines and the dynamos, *up to their terminals*, being in charge of the engineer; all other parts, viz., fuses, switchboard, measuring instruments, circuits, lamps, &c., and even motors, come under the charge of the torpedo lieutenant. This arrangement gives rise to many difficulties in practice.

The switchboard, which is kept locked up, is in a different part of the ship to the dynamos, so that the dynamo watchkeeper has no access to it, consequently when it is necessary to change the load over from one dynamo to another (perhaps because of a hot bearing) a messenger has to be sent from the engine room to find the leading torpedo man of the watch to tell him to switch over. Now, generally, this man is very difficult to find in a big ship, as he may be anywhere, perhaps seeing to a joint in some remote part of the ship; so in practice the operation of switching the load on to another dynamo takes from a quarter of an hour to half an hour, inclusive of messenger's time, &c. This delay often means that the engineer has to choose between damaging his engines, or putting the whole ship in darkness by stopping his dynamo. This absurd state of things would be avoided if the dynamo watchkeeper had charge of the main switchboard, it being placed within his reach. The time taken to change over would then be reduced to about three minutes, as generally a stand-by machine is kept running slowly.

At present, the engineering staff does not allow of a more suitable person than a stoker for dynamo watchkeeper, who, if anything goes wrong, is generally useless, and has to send for an engineer officer. If a better type of dynamo watchkeeper were available, who would be capable of also looking after the switchboard, as before proposed, there would be a far smaller chance of serious breakdowns occurring.

The electrical instruments chosen for use in H.M.'s ships are not of the best or most suitable type. When a man is looking after an engine and dynamo with, perhaps, an ever-changing load, as when running search lights, it should not be necessary for him to leave his stop valve and dynamo

brushes *to twist a pointer round* in order to know what current the machine is giving. Why, then, is an ammeter of this type used?

The testing instruments supplied are most unsuitable. What better instrument for testing insulation could be found than Evershed's portable testing set, now used so much? Such an instrument would seem specially suited to ship use, owing to the simple manner of using it, and its portability, but instead, one finds other instruments and apparatus in use comprising delicate galvanometers, Wheatstone bridges, Daniell cells, &c, which not only require greater skill in connecting up correctly (a point not to be underrated), but, to a great extent, they lack portability, and of course have the disadvantages of testing with a very low pressure compared to the working voltage.

Why should joints so often be made by baring the wires to be jointed, twisting them together (no solder), and binding up this joint with cotton tape, using string to keep the tape on? It only shows that those who allow joints to be made in this way do not realise the importance of making a proper joint—in other words, it shows ignorance.

The position of dynamos is another point which allows of improvement. One sees them placed in corners of engine rooms, in close proximity to other engines, regardless of the oil and dirt that surround them, and sometimes without allowing free access to the brushes and commutator. This is rather evident in one of our newest battleships, H.M.S. *Canopus*.

Everyone knows that the modern warship is cramped for space; but if more notice were taken of the importance of keeping dynamos in their best working condition, it would probably be found advantageous to separate them from the oily influences of the engine room. These are all points which show that there is much room for improvement, and seem to point to the fact that matters electrical are not looked after in our Navy by capable men. Such companies as the P. and O. Steam Navigation Company find that it pays them to have an electrician on board their ships. Would not the Admiralty benefit the efficiency of our ships by doing the same, more especially as the uses of electricity are not confined to lighting alone? Torpedo lieutenants are naturally far from being electrical engineers, and engineer officers have no electrical training worth speaking of. One must not forget that "a little knowledge is a dangerous thing."

With regard to our dockyards. A system of electrical plant which would not only provide for the general lighting of the dockyard, the various workshops, &c., but enable any ships undergoing repairs, either in docks or basins, to join up from suitably placed terminal boxes to their own lighting system, would seem a move in the right direction. This is only done on a very small and inadequate scale, the tallow candle being far too much in evidence in ships undergoing repairs. This is a matter of considerable importance; good internal lighting influencing to a great extent the time taken and the quality of work done.

An extract from a letter recently received from a naval engineer officer in the Mediterranean Station may be of interest. He says:—"I am at present mending a wounded dynamo, which nearly burned up as to its field windings, owing to a prolonged overload caused by an ammeter which showed 150 amperes less than it ought (this instrument had been 'adjusted' by a torpedo man of sorts), and fuses which were too big. It might interest you to know that the main fuses are the same size as all other fuses on the switchboard leading off to the various circuits. You can easily see how well the sub-circuits are protected."

Is not this in itself rather a startling statement to read about one's first line of defence?

R. T. I. C.

Fatality.—On Tuesday last week Mr. Milligan, deputy coroner for Wigan, held an inquiry relative to the death of John Witts, 41, electrician. Witts and a man named Davies were in charge of a coal-cutting machine at the Ellerbeck Colliery, Coppull, when owing to a signal being misunderstood the current was switched on, and Witts was fatally injured. The jury returned a verdict of accidental death, and expressed the opinion that Davies had switched on the current owing to misapprehension.

BUSINESS NOTES.

Bankruptcy Proceedings.—At the London Bankruptcy Court last week John E. Evered, manufacturer, 32, Museum Chambers, Bury Street, and 12, Miller Street, Camden Town, applied to Mr. Registrar Hope for an order of discharge. According to the report of the Official Receiver the bankrupt failed last June, owing £7,905. The assets have only realised £10 16s. 7d., so that no dividend can be paid to the creditors. In July, 1898, he was appointed commercial agent to the Electrical Undertaking Company, Limited, and from about November, 1898, to February, 1899, he acted also as superintendent of the company's factory. He was, however, dismissed from the post in the latter month and was without employment until the failure, which was ascribed to excess of expenses over income; losses by betting and Stock Exchange speculations; and to a liability on a dishonoured acceptance for £500 given by him in payment of the purchase price of 50 shares in the said Electrical Undertaking Company, Limited. The offences reported by the Official Receiver were (1) insufficiency of assets to pay 10s. in the £ to the unsecured creditors; (2) contracting a debt provable in bankruptcy without reasonable or probable ground of expectation of being able to pay it; and (3) contributing to the bankruptcy by rash and hazardous speculations, gambling and extravagance in living. After hearing Mr. Monk for the debtor, his Honour upheld the report, and suspended the order of discharge for four years from the conclusion of the public examination in July, 1899.

Liquidations, Dissolutions, &c.—Messrs. F. H. Medhurst and A. Kitchin (Medhurst & Kitchin), consulting electrical engineers, Victoria Street, S.W., have dissolved partnership. Debts, &c., will be attended to by Mr. Medhurst.

Creditors of the Lithanode Electric Storage Company, Limited (in liquidation), are to send particulars of debts and the usual information to Mr. F. Stuttaford, solicitor to the liquidators, 11, St. Helen's Place, E.C., by July 19th.

A petition presented by S. Sewell, 168, Victoria Street, S.W., a creditor, for the winding up of the Westminster Automatic Telephone Syndicate, is to be heard on Tuesday, June 26th, by Mr. Justice Wright.

Books Received.—Nos. 45 to 55, "Fire Tests with Floors." London: The British Fire Prevention Committee. 1900. 2s. 6d. net.

"Proceedings of the Northern Society of Electrical Engineers,' November, 1898, to December, 1899. Manchester: Thos. Sowler and Sons, Limited. 7s. 6d.

"Electric Tramway Traction." By A. D. Greatorex. London: St. Bride's Press, Limited. 1900.

"Silvertown and Neighbourhood." By A. P. Crouch. London: Thos. Burleigh. 1900. 1s.

"The Cyanide Process of Gold Extraction." By James Park. London: Chas. Griffin & Co., Limited. 1900. 6s.

Brochure.—A neat and well-printed little pamphlet has been issued by Mr. Chas. Turnbull, electrical engineer to the Tynemouth Corporation, explaining the system of charging, the "free" wiring arrangements, and numerous applications of electricity to lighting, heating, power, &c., in simple and entertaining language.

Catalogues and Lists.—The Volt Electrical Company, Limited, Birmingham, send us advance sheets of their catalogue. The items illustrated include switches of various types, key lampholders, cut-outs, ceiling roses, wall plugs, fuses, and fuse-boards. Prices are given in clear form, and the sheets are not over-crowded with useless matter. Pending the production of the complete catalogue, the advance sheets will be sent on application.

A booklet, entitled "Combined Tramcar Braking and Heating Apparatus," comes to hand from the Westinghouse Companies' Publishing Department. The brake described therein is manufactured by the Westinghouse Brake Company, Limited, and was invented by Mr. F. O. Nowell, an American street railway man. It is claimed that by this invention an excellent braking effect is secured by combining a magnetic track brake with the levers of the ordinary hand brake. Where electric heating is desired, the parts of the apparatus are so combined as to effectively heat the cars without requiring additional energy from the line. The pamphlet is arranged in that exceedingly pleasing manner which is characteristic of Westinghouse publications.

A pamphlet with explanatory drawings and description of Rankine's patent feed water filters comes to hand from the Rankine Patent Feed Water Filter Company, Limited, of Liverpool.

Messrs. Barry, Head & Co., of Lombard Street, send us a note of their basis prices for iron and steel bars, sheets, angles, &c., &c.; also lists of the iron and steel specialities of Messrs. Fox, Head & Co., the Steel Casting Company, and Wm. Whitwell & Co.

From Cresswell's Asbestos Company we have received their catalogues No. 6 and 7, relating to their asbestos goods, manufactures, lubricants, oils, belting, syrups, &c.

We have received from Electricité and Hydraulique Société Anonyme (Julien Dulait, Administrateur-Gérant), of Charleroi, an illustrated pamphlet, in which is given a description of the installation carried out by them in connection with the Bruxelles Ixelles-Boendael tramway in 1896 97. Photographic reproductions of the boiler and engine rooms, the car shed, and the cars on the line appear.

Messrs. B. Young & Co., of Birmingham, send us a net trade price list of their standard continuous current dynamos and motors, with a general specification of same.

Electric Plant for Sale.—The St. Helens Electric Supply and Tramways Committee want tenders for the purchase of a 120-kw. direct driven Robey—Johnson & Phillips' steam alternator and exciter, a 25-kw. ditto ditto horizontal surface condenser and condensing plant, Ferranti switchboard and gear, various transformers, steam piping, &c., at their Warrington-Road Works.

Free of Duty.—The *Board of Trade Journal* says that H.M. Commercial Attaché at Berlin reports, in a recent memorandum, that the German *Central Blatt*, of May 25th, contains a notice to the effect that the Bundesrath, in its Session of the 3rd ult., decreed that apparatus and materials for electric lighting installations on sea-going vessels, including search-lights and their appurtenances, shall in future be admitted free of duty into the German Customs Union.

Isle of Man Tramways Company.—In the Manx Chancery Court last week, Robert Okell, a creditor, petitioned for the compulsory winding up of the Isle of Man Tramways and Electric Power Company, Limited, and the appointment of Mr. W. H. Walker, of Liverpool, as liquidator. As all directors have retired the company did not appear. A number of shareholders were represented by counsel and opposed the application. It was pointed out that a meeting of shareholders was to be held, and an adjournment was asked for till the result of the meeting was known. The petition was adjourned till Thursday (yesterday).

The adjourned meeting of shareholders was held at Douglas on 15th inst. The annual meeting held on the 24th ult. appointed a committee to consult with and advise the directors as to the best means of extricating the company from its financial difficulties. It now transpired, says the *Financial Times*, that since the meeting two out of the three remaining directors had sold their shares and forfeited their qualification. The remaining director, Mr. J. A. Mylrea, presided, but placed his resignation before the meeting. He explained that a creditor had presented a petition to have the company wound up, and the petition would be heard on Monday. The committee could not present a report, as the members of it were divided. One section favoured another effort to raise money, and the other declared it was hopeless to expect to raise money. The management of the concern by the directorate was strongly denounced. Eventually the meeting was further adjourned to Tuesday to allow the vacancies on the board to be filled.

Motor Car Charging Stations.—We are asked to state that electric motor cars can now be used anywhere between Oxford and London. Mr. W. Rowland Edwards, A.M.I.E.E., of the Thames Valley Launch Company, Limited, announces that that company's charging stations are now available for this purpose at the following places:—Weybridge (River side), Maidenhead (Boulter's Lock), Henley (at the Lock), Pangbourne (works adjoining Whitchurch Bridge), Shillingford Bridge, and by arrangement with the Oxford Electric Light Company, Limited.

"Powerful" Watches.—A watch was given to each of the officers and men of H.M.S. *Powerful* on Thursday evening last week, the ship being paid off the next day. The presentation was made by the Mayor of Portsmouth. The order for these watches was executed by Messrs. Samuel Smith & Son, Limited, and they have been made of a new type and design. The cases are plain silver full hunters, very close fitting so as to be damp proof, the front cover engraved with the name of the recipient, and his rating on board ship. The movement has a special escapement to withstand vibration and change of temperature. Instead of steel, gold hands have been used to prevent damage from damp, and the winding is keyless.

Private Bills.—In the House of Lords on Monday, the second reading of the following Bills was agreed to:—Nottingham Corporation Bill, South Lancashire Tramways Bill. The following Bills were read a third time and passed:—Liverpool Overhead Railway Bill, and the Southport Extensions and Tramway Bill.

In the Commons the following Bills have been read a third time:—Huddersfield Corporation Tramways, Jarrow and Hebburn Electricity Supply.

In the House of Lords on Tuesday, the following Bills were read a second time:—City of London Electric Lighting, Charing Cross and Strand Electricity Supply, South-Eastern Metropolitan Tramways. The following were read a third time and passed:—Sheffield Corporation, Salford Corporation, Glasgow District Tramways, Central London Railway, Stockport Corporation Tramways.

Trade Announcements.—The British Electric Works Company, Limited, have opened a branch in Manchester for the supply of their electrical fittings. They have secured a very central position at 37, Piccadilly, and have engaged the services of Mr. John Walton, who was for several years with the Manchester Electricity Supply as inspector of installations. Mr. Walton also had charge of all the testing of accessories submitted to the Manchester Corporation. Mr. Walton's district consists of the immediate Manchester district lying between Warrington, Todmorden, and Blackpool.

We are informed that Messrs. Evershed & Vignoles, Limited, of Woodfield Works, Harrow Road, London, have opened a City office at 110, Cannon Street, E.C., where they are represented by Mr. P. F. Brittain, and where all information relating to Evershed instruments, together with catalogues, prices, and quotations, may be obtained.

The Lancashire Dynamo and Motor Company, Limited, inform us that their registered office address is now Trafford Park, Manchester.

The Edison & Swan Company have already the sole agency for the Hart accumulator cells for the towns of Glasgow and Dublin, and similar arrangements have been entered into by this company to represent the Hart cells in Belfast and Cork.

ELECTRIC LIGHT AND POWER NOTES.

Ambleside.—The Electric Lighting Committee of the District Council has recommended that the Council should lease its provisional order to the Windermere Electricity Supply Company, and the Council has decided to adopt the suggestion.

Bangor.—The National Electric Wiring Company, Limited, have opened a branch office at Bank Place, Bangor. The electrical works of the city are rapidly approaching completion.

Burton.—The sale of electrical energy during the past year resulted in total receipts £3,733, an advance of 33 per cent. on the previous year. The expenditure amounted to £3,738, almost the same as in 1899, leaving a deficiency of £5 odd. During the year the old rubber cables were replaced by paper insulated cables of the British Insulated Wire Company's make at a cost of £2,359.

Colne.—The Town Council has decided to apply to the Local Government Board for sanction to borrow nearly £40,000 for the purposes of an electric lighting scheme. The plant will be laid down as required, and the installation will provide for the supply of current for the Colne and Trawden Light Railway when it is constructed.

Coventry.—The report of the Electric Light Committee for the past year shows that the lamps connected have increased from 10,699 to 17,806, and further connections are being made. The number of units sold has increased from 149,547 to 229,607, and the revenue from £3,597 to £4,189. In comparing these figures, it must be borne in mind that last year's report covered a period of 15 months, and also that during the year which has just expired electric street lighting has been inaugurated. The profit on working is £786 against £338 for the previous 15 months. This would have been substantially greater but for the rise in the price of coal. Deducting the working profit of £786, the net charge on the rates is £1,745 against £1,619 last year.

Cupar.—The Lunacy Board has appointed Mr. Mackenzie, of Edinburgh, to report on the cost of electrically lighting the asylum.

Dalkeith.—At a special meeting of the Burgh Commissioners last week, the report of a committee as to the advisability of an electric lighting scheme for the burgh was submitted. The Commission resolved that the offer of Messrs. Crompton & Co., Limited, on which Mr. A. A. C. Swinton had reported favourably, be accepted, and that Messrs. Crompton be authorised to apply for a provisional order subject to modification and adjustment.

Devonport.—The Borough Council last week approved of a recommendation by the Electric Lighting Committee that a tender of £12,433 be accepted for cables and underground boxes.

Dublin.—At a meeting of the local branch of the Institution of Electrical Engineers, Mr. Robert Hammond described his electric lighting scheme and defended it. Mr. Porter referred to the question of the Pigeon House Fort foundations, and others took part in a lengthy discussion to which Mr. Hammond duly replied.

Dudley.—At a meeting of the Town Council last week the Railway, Tramway, and Electric Lighting Committee recommended that the Corporation should wire the premises of all consumers of electricity free of charge. The Committee also recommended that consumers should have, until further notice, the option of being supplied at the rate of 5d. per unit throughout, or at the rate of 6d. per unit for two hours a day (between 5 and 7 in the winter and between 6 and 8 in the summer), and 1½d. per unit for the remaining 22 hours, and that no rentals be charged for meters. The Council agreed to an application for sanction to borrow £10,000 for wiring premises for electric lighting purposes.

Dysart.—The Town Council have had under consideration an offer from Messrs. Crompton & Co., Limited, to provide electric lighting for the district. A committee was appointed to inquire into the matter.

East Grinstead.—The District Council has decided to apply for a provisional order for the supply of electricity, provided a satisfactory agreement can be made with a responsible company.

Gillingham.—The Urban District Council has been informed that after October 1st the price of energy will be reduced to 5d. (instead of 7d. per unit, as at present) for the first hour's nightly consumption, and 2d. per unit for all consumed in excess. The company also intends introducing a system of free wiring.

Glossop.—The Town Council has completed the transfer to the Urban Electric Supply Company, Limited, of its electric light order.

Greenock.—At a meeting last week of the Finance Committee of the Greenock Police Board, it was agreed to double the present capacity of the electrical works, at an estimated cost of £8,000, to meet the demands in connection with the tramways.

Heywood.—The Town Council has decided to apply to the Local Government Board for sanction to the borrowing of £15,000 for the purposes of the electric lighting scheme.

Halesworth.—The Colchester Brewing Company are about to put down an installation for lighting the brewery with electricity, and as they have received applications from many tradesmen to light their premises, the company proposes to put down a larger plant, so as to light the whole town if desired. Before doing so they would be obliged to obtain an order from the Local Government Board to enable them to carry overhead wires to different parts of the town. The District Council has appointed a committee to ascertain what the result of acceding to the application of the Brewing Company would be, and how far the proposed order would bind the Council in any future action it might wish to take.

Hereford.—The accounts of the electricity works for the last quarter show receipts £274, payments £576, leaving a deficit of £302; but of this amount £247 is due to repayment of capital and interest, so that the deficit on the working is really very small.

Hornsey.—The provisional order of the Hornsey District Council will expire next month, but the Electricity Committee has obtained from the Board of Trade an extension for 18 months from June 1st, on the ground that there was a lengthy report before the Council which was being considered.

Hull.—At the last meeting of the Works' Committee a discussion arose regarding the patent stokers at the electricity station. It was stated by Alderman Larard that these had not been the success they had anticipated for them. Mr. Hanger said that on February 21st the Committee had the matter of the mechanical stokers before them, and the engineer was instructed to make inquiries about a fresh motor. The mechanical stokers were entirely under the control of one electrical motor, and in the event of it giving out—and there were dangers of it doing so—the four boilers could not be stoked, not even by hand. He contended they were running a very serious risk in trusting all those boilers to one motor, but from February 21st to the present time they had not received any report from the engineer. Then, again, with regard to the boiler feed, they were now trusting to the injectors alone, and these were not qualified to do the work as they should do. Again, in his opinion, they had not sufficient power at the works. Those matters, together with the question of wages and hours of work, ought to be thrashed out with the experts. There was another point—that of the accounts. In every other Committee the accounts had already been entered on the minutes, but theirs had not. He said it was an important matter that the Tramways Sub-committee should meet as soon as possible. He contended the tramway station was in a very delicate position in the sense that they might have very serious difficulties.

India.—The cordite factory which is to be established at Arvenghaut is to be worked by electricity, which will be provided from the Kateri Waterfalls.

Jedburgh.—The Police Commissioners have approved of a recommendation that Messrs. Crompton & Co., Limited, should apply for a provisional order for the installation of the electric light at Jedburgh, subject to conditions.

Kilmarnock.—The Watching and Lighting Committee last week recommended the Council to apply for a provisional order for borrowing powers to the extent of £50,000, the estimated cost of the electricity scheme being £26,000. The report was carried.

King's Lynn.—An inquiry was held by Mr. H. P. Boulnois on the 13th inst. into the application of the Town Council to borrow the sum of £10,000 for extensions of the electric lighting works. The town clerk explained that the extensions were rendered necessary by the increase in the demand for current, which had been far greater than was anticipated at the time the original plant was laid down. At the present time there were 1,188 lamps of 8 C.P. equivalent connected in excess of the capacity of the plant, which would serve simultaneously 5,544 lamps of 8 C.P. The resident engineer, Mr. Pilling, stated that the proposed extension would allow 9,200 additional lamps of 8 C.P. to be connected to the mains. The new plant would consist of two steam dynamos, one of 200 KW., and one of 120 KW., with Lancashire boilers and Belliss high speed engines, &c. Mr. G. H. Davies, for the opposition, urged that the proposed expenditure should be delayed for a further 12 months, to allow of the success of the electric light undertaking being fairly judged. After the conclusion of the inquiry the inspector visited the works.

Leeds.—The Council has authorised the formation by the Lighting Committee of a reserve fund, to be called the Electric Lighting Equalising Fund, and ordered the payment into such fund of the sum of £8,287 from the surplus profit of the electric lighting undertaking.

The Council has also authorised the Committee to contract for the supply of two sets of generating plant and one of condensing plant for the electric lighting works, at a cost not exceeding £15,000.

London.—BERMONDSEY.—The Electric Lighting Committee reported at a meeting of the Vestry on Monday that the Board of Trade had arranged for a conference to adjust the areas of supply under the Vestry's provisional order and those under the County of London and Brush Company relating to the parishes of St. George-the-Martyr and Camberwell, so as to coincide with the new borough boundary determined by the Commissioners under the Local Government Act, 1899. Mr. T. Cox, chairman of the Committee, mentioned that he and the Vestry clerk had attended the conference when the alterations were duly made. The Committee recommended that no action should be taken in regard to the request of the Marylebone Vestry for co-operation in opposing the Bill introduced to confirm the provisional order granted to the Marylebone Electric Supply Company. This was agreed to without discussion. It was stated by the Buildings Committee that plans, sections and elevations of the generating station had been submitted by Messrs. Kincaid, Waller and Manville. It was decided to approve the drawings and to invite tenders for carrying out the work on the completion of the specification and quantities.

SHOREDITCH.—At a meeting of the Vestry on Tuesday a letter was read from Mr. H. E. Kershaw, resigning the vice-chairmanship and membership of the Lighting Committee. No reason was adduced for this action, but it is probably due to the change in chairmanship of the Committee. The resignation was accepted. The Lighting Committee subsequently reported that Mr. N. Moss had relinquished the chairmanship of the Committee, and that they had elected Mr. H. Winkler to the position until the Vestry becomes a borough council. The motion to receive the report having been moved by Major Wenborn, Mr. J. T. Clark proposed, as an amendment, that the report should be referred back for further consideration. An animated and personal discussion ensued, in the course of which Mr. Kershaw stated that he was no longer a director of an electric lighting company, and that he was absolutely unfettered. Eventually the amendment was rejected by a large majority, and the report was then received.

It was stated by the Lighting Committee that Mr. Russell, the engineer, had reported on the expediency of connecting the sub-station in Reeve's Place with Great Cambridge Street, so as to supply that district without waiting for the completion of the new generating station in Whiston Street. The cost of laying the ducts and cables would amount to £3,250, and on the recommendation of the Committee the Vestry sanctioned the expenditure, and authorised them to obtain prices for the cable. An expenditure of £350 was also approved for the formation of a subway for mains between Coronet Street and Pitfield Street.

MARYLEBONE.—The Vestry has resolved to re-commence the action against the Metropolitan Electric Supply Company, in connection with the breaking up by the company of the carriageways in Edgware Road and Queen Street for the purpose of laying through mains, without the consent of the Vestry.

Melbourne.—An interesting report was presented at a meeting of the City Council on the 7th ult., embodying the accounts of the electricity works for the last two years; the issue has been delayed by a technical difference between the Electricity and Finance Committees. For 1898-99 the gross revenue was £26,601, the expenses £17,106, and the gross profit £9,495. After deducting interest, sinking fund, &c., the net profit was £805. The capital expenditure stood at £108,640, and the sinking fund at £13,584. On Major Cardew's recommendation the mode of formation of the sinking fund was modified; 3 per cent. per annum on the capital invested is now applied to this purpose. For last year, up to the end of February, 1900, the gross revenue was £29,850, the expenses £17,818, and the net profit £4,968. There are 834 street lamps, and over 1½ million units were sold. On the recommendation of the Electric Supply Committee the Council resolved to acquire the electric supply undertaking of Messrs. Draper & Co., for the sum of £11,000.

We read in the *Melbourne Age* that the Postmaster-General was seen on May 1st, by representatives of the Electric Lighting and Traction Company of Australasia (English syndicate), the A.U. Alcock and the New Australian Electric Light companies, and the Melbourne City Council, who asked that some way out of the difficulty that had arisen in connection with the proposed transfer of orders to the English proprietary should be found without delay. Mr. Watt explained that it was within his power to grant the English company an entirely new order under Section 10 of the Electric Light and Power Act, provided that the Victorian companies' orders already in existence were cancelled. These orders, it was pointed out, had about 20 years to run, but if a substantive order were issued the municipalities concerned could apply to have the whole matter gone into again. The question which the companies interested have now to decide is whether they will wait for the passage of the remedying Act which Mr. Watt purposes introducing next Session or agree to the whole matter being recommenced. The officers of the electrical branch of the Postal department are conferring with the companies' representatives with a view to expediting the solution of the problem.

Morecambe.—The electric light works show a profit on the year of £1,764, against £775 last year. The plant and buildings cost £39,700, of which £2,500 has been repaid. The revenue has increased by £2,000.

Oldham.—The annual statement of the electric light works shows that the expenditure on capital account during the year ending March 25th last was £9,314. The gross revenue for the year amounted to £8,482, and the gross expenditure to £5,050, the balance carried to the net revenue account being £3,432. The net profit for the year was £224, and the balance brought forward from the last year was £885, making a credit balance to be carried forward of £1,109. The amount in the reserve fund on March 24th was £4,412. The amount of energy generated had been 679,475 units, of which 576,853 units had been sold. The number of lights supplied was 32,615, being an increase during the year of 4,144. The number of consumers was 398. The prices charged for energy during the year have been as follows:—Without demand indicators: First 1,000 units per quarter, 4d. per unit.; second 1,000, 3½d.; third 1,000, 3d.; fourth 1,000, 2½d.; fifth 1,000, 2d.; all in excess of 5,000 units, 2d. With demand indicators: First 2 hours daily average maximum demand per quarter 4d. per unit; afterwards 2d.

per unit. During the year contracts have been let for an additional engine and dynamo of 360-H.P. capacity, and for four additional boilers, &c. When those are completed the site of the present station will be fully utilised. The total horse-power in the station on March 25th was 1,800. Application was made to the Local Government Board for powers to borrow a further sum of £36,000 to carry out extensions and additions to plant, and an inquiry was held on January 9th, 1900, but up to the present time the reply to the application has not been received. A plot of land has been secured for the purpose of further extentions.

The Technical Education Committee of the Oldham Corporation is contemplating holding classes for electrical engineering in the Technical School during the coming winter, and with that object in view is making inquiries respecting teachers from the electrical works in the town.

The cooling tower at the electric generating station is going to be utilised for a double purpose. The chairman of the Electric Light Committee considers that it would admirably serve the purpose of a bill-posting station, and his colleagues on the committee quite favour the scheme. It was remarked that the income would pay the interest on the money borrowed for the tower, and that the advertisements would cover the "big ugly thing." The idea was to save expense, apart from appearances. We are reminded of the kirk session which solemnly debated the advisability of letting out the pulpit for the same reasons.

Paisley.—The reports of Prof. Barr and Mr. Cormack on the new engines offered by Messrs. Ferranti, Limited, in place of the three at present installed at the electricity works, have been considered by the Town Council. The reports state that while the valve gear of the present engines is of insufficient strength, the engines have suffered from excessive cushioning, due to being run non-condensing, although they were specified to be condensing. The valve gear of the large engine under construction was reported on favourably, and the Council agreed to inform Messrs. Ferranti that the committee was favourably impressed thereby, and to ask for particulars of the smaller engine.

Pembroke.—The new electricity works of the Pembroke Urban District Council are practically complete, and it is expected that the formal opening will take place in the course of a few weeks. The cost of the plant will be about £30,000, and there will be capacity sufficient to supply over 6,000 lamps. The plant consists of three Lancashire boilers, working at a pressure of 140 lbs. per square inch; two compound engines of the enclosed type, which run at a speed of 375 revolutions per minute, each developing 250 I.H.P.; and two 75 KW. four-pole dynamos. The battery consists of 280 cells. The distributing cables are fed by four large feeder cables. Eighteen arc lamps have been erected for the principal thoroughfares, other streets being fitted with 100 lamps, having two 16 candle-power lights on each standard. The scheme was designed by Mr. Hammond, and has been carried out under the supervision of Mr. L. L. Robinson.

Poulton.—At a meeting of the newly-constituted urban authority last week, a committee was appointed to take into consideration the matter of introducing electricity for the public lighting of the town. Poulton, with its thatched roofs, one storey buildings, and ancient stocks, is going to add the *arc* to its other old associations!

Salford.—The Electric Light Committee of the Town Council seems to be falling to pieces. Six or seven members have resigned, owing, it is said, to disagreement, and the Committee is to be reconstituted. Whether the trouble is connected with the proceedings relative to the late electrical engineer or not, is not revealed.

Shanklin (I.O.W.).—A fresh scheme for lighting the town has been submitted to the District Council by Edmundson's Electricity Corporation. They stated they understood the town was paying £3 per annum per lamp for 169 lamps of 16 C.P., the cost being £507. The company would supply 30 C.P. lamps at £2 10s. per lamp per annum, and, if for a term of seven years, fit the lamps free of charge. Another scheme was to erect 10 arc lamps of 750-C.P. at £12 per annum each, equalling £120, and 149 ordinary lamps at £2 10s., equalling £372, or a total of £492. The proposal will be dealt with by the Council in committee.

Southwold.—The Coast Development Company have decided to put down a complete electrical installation for the lighting of their new hotel and pier at Southwold. Edmundson's Electricity Corporation have obtained the contract, which is to be carried out according to a specification prepared by Mr. A. A. Campbell Swinton, M.Inst.C.E.

Twickenham.—The Middlesex County Council has presented a petition against the preamble of the Twickenham Electric Lighting Order, alleging that provision should be made in the Bill for the final control of the main roads to be vested in itself. The District Council will oppose the petition.

West Ham.—The electricity accounts have been published, showing a gross profit of £2,002, net profit £470. The latter was transferred to the rates in part payment of the previous losses charged to that account, amounting to £1,380. The average price obtained was 4·32d. per unit for public and 1·91. for private lighting.

Whitby.—The District Council has received sanction to borrow £26,000 for electric lighting purposes.

ELECTRIC TRACTION NOTES.

Ambleside.—The Urban District Council has consented to join in conference with the Windermere District Council and the Windermere Electricity Supply Company (acting on behalf of the British Electric Traction Company) with reference to a proposed light railway between the two towns.

Brighton.—The Tramways Committee of the Town Council have recommended the appointment of Mr. Thomas B. Holliday as tramway engineer to the Corporation during the construction of the tramways specified in the Bill now before Parliament, at a salary of £600 per annum.

Dudley.—At the Council meeting last week Alderman Dunn, chairman of the Electric Lighting and Tramways Committee, made a statement respecting the award of Sir Courtenay Boyle concerning the price of electricity to be supplied by the Council to the British Electric Traction Company, Limited, for the tramways in the Dudley borough. The current would be supplied at the rate of 2d. per unit for the first 150,000 units; any further amount up to 200,000 units $1\frac{8}{10}$d., up to 250,000 units $1\frac{6}{10}$d., up to 300,000 units $1\frac{7}{10}$d., up to 350,000 $1\frac{1}{2}$d., up to 400,000 $1\frac{3}{10}$d., and for any quantity in excess of 400,000 1d. would be charged. He might say that the Council had never tried to take any advantage of the company. They had always endeavoured to work with them, and had offered them every facility, considering that what they were doing was not only for the benefit of the town, but also of the surrounding districts. It was very important that the generating plant should be kept fully employed, as the ordinary expenses were going on whether it was kept unemployed or fully engaged. He thought the agreement one of the best possible. In four years from August 11th, 1898, the tramways within the borough would be taken over by the Corporation at a price to be fixed by the Board of Trade, unless an agreement was come to, and it would be then re-leased to the company for a further 21 years. With regard to the electric lighting scheme, the engineers had informed him that the hours he had fixed, as mentioned in the report, would be from 5 to 7 in winter and 6 to 8 in summer. The terms (which had been published) were lower than in surrounding towns, and in a few years he hoped they would be still less.

Gothenburg.—The Gothenburg City Council have decided, says *Commercial Intelligence*, that the city itself shall build and run the new electric street railways. In all probability the proposed lines will be extended considerably, and more rolling stock and other material will be needed than was at first estimated. British firms intending to compete with Swedish and German manufacturers should address communications to Figge Blidberg, Esq., engineer, manager of the City Tramways, Gothenburg.

Light Railways.—The Board of Trade have, after modification, confirmed the Bexhill and St. Leonard's Light Railway Order, 1900, the Cheltenham and District Light Railway Order, 1900, and the Cheltenham and District Light Railway (Extension) Order, 1900.

Liverpool.—On Wednesday the new electric tram service, inaugurated by the Liverpool Overhead Railway Company, was to be opened from Seaforth Sands to Waterloo, for the convenience of the people of the outlying townships. Ultimately it is intended to extend the system to Great Crosby. The length of the tramlines already laid down is about 1 mile. The system is precisely that of the City Corporation, viz., the trolley; the cars are also identical. Altogether 10 cars will be put on when the line is in full swing. The fare is to be 1d.

Swansea.—On Thursday last week, on behalf of the Board of Trade, Colonel Yorke inspected the new permanent way of the Swansea tramways, and Mr. Trotter the electrical installation. A number of officials of the British Electric Traction Company, the owners of the line, were present. The tramways, which have been relaid throughout their entire length by the British Electric Traction Company, are about $5\frac{1}{2}$ miles in extent, and include three sections, viz., the town section (St. Helen's Road to Alexandra Road and the Docks), the Cwmbwrla section, and the Morriston section. On the whole the gradients are favourable, the worst being at Cwmbwrla, where, however, it does not exceed 1 in 15. Callender cables have been laid in metal pipes under the streets, and the poles and brackets are of a neat ornamental design. No special difficulties had to be faced, and the whole line was taken up and relaid without obstructing the traffic. The power house is situate in St. Helen's Road, in the old tramway depôt, and consists of one main building, which is used as an engine room, and a smaller room, used as a boiler house. The building is of a very solid style and material, being built of red facing bricks. The stack is 135 feet high. There is also a small wing, which is used for offices. Inside the engine room there are two 200-KW. Westinghouse generators, directly coupled to two 350 I.H.P. Ball & Wood engines, running at 200 revolutions a minute at a steam pressure of 150 lbs. The machines are eight-pole, having an output of 400 amperes at 550 volts. The engines are of a compound tandem type, with a heavy fly-wheel. Further, there is a combined steam motor-generator plant, consisting of an Alley & Maclellan "Sentinel" high speed engine of 50 B.H.P., 450 revolutions. On the same bedplate are two 20-KW dynamos, one at 500, and the other at 100 volts; these are so arranged, that when the main engines are running, the 500-volt side is used as a motor, driving the 100-volt dynamo for lighting and motor purposes. In the boiler house are two Babcock and Wilcox boilers, fitted with superheaters, and capable of evaporating 7,000 lbs. of water per hour.

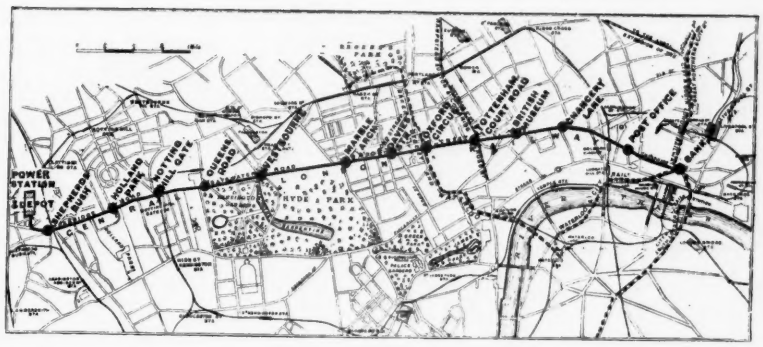
(*Continued on page* 1063.)

CENTRAL LONDON RAILWAY.

(*Continued from page* 1016.)

HAVING now dealt with the generating, distributing, and transforming apparatus, we come to the final stage of the operations—the line and rolling stock, which constitute the essence of the scheme.

As already stated, the tunnels are for the most part 11 feet 6 inches diameter, and are entirely separate, except at some of the passenger stations, where there are cross-over roads and sidings. One of the most interesting features of the line is the system of gradients employed, by means of which an immense economy is secured. Immediately after leaving each station the train descends an incline of 3·3 per cent., so that gravitation to the extent of 3·3 per cent. of its total weight is brought into play, assisting the locomotives to produce a rapid acceleration, and thereby reducing the maximum demand to one-half of what it would have been had the line been level. When approaching a station the train runs up a gradient of 1·66 per cent., by which its motion is retarded; thus, not only are the brakes relieved, with consequent saving of wear and tear, but a considerable amount of potential energy is stored up in the train to assist it in starting again. As the length of the incline is about 600 feet, and the weight of the train 150 tons, the stored energy amounts to about 100-H.P.-minutes; this is given out in descending the starting grade in less than a quarter of a minute, so that the power in aid of the motors during this period amounts to more than 400 H.P.!



MAP OF ROUTE.

We give a map of the route followed by the line, together with diagrams of the gradients, which show the profile of the lines in both tunnels. As the surface roadway near the Post Office is very narrow, and as the route has been arranged to follow the roads in order to reduce difficulties with house owners, the up line here passes under the down line, the stations being at different levels. The track is of standard gauge, laid with rails of the shape shown in one of our figures. These rails are of steel, and weigh 100 lbs. per yard; they are double bonded throughout with Crown bonds.

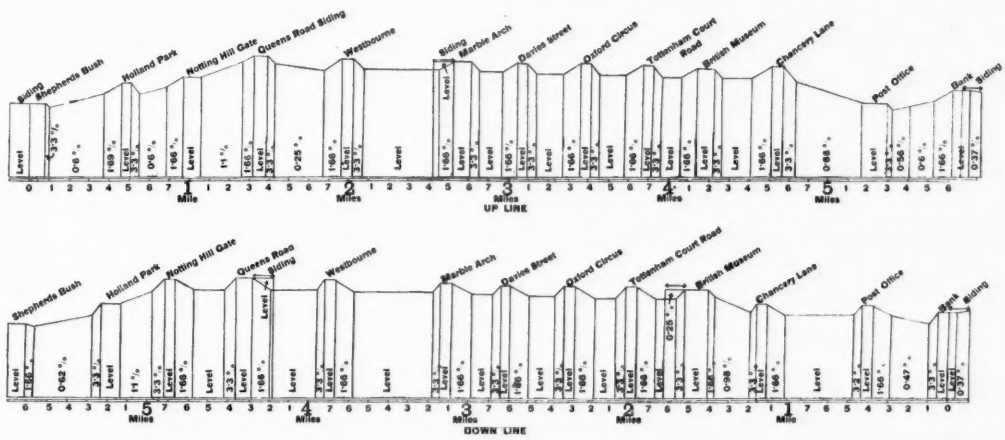
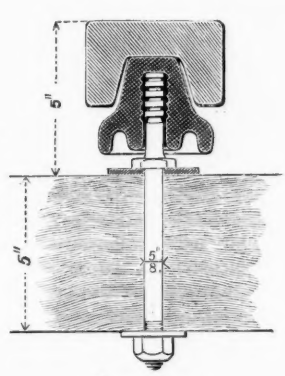
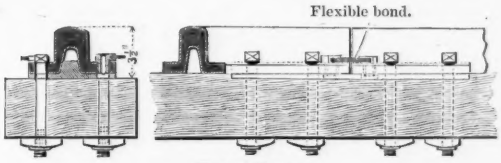


DIAGRAM OF GRADIENTS.



THIRD RAIL.

The third rail is of mild steel, with a remarkably small percentage of constituents other than iron; the average analysis shows these to be as follows:—Carbon, 0·030 per cent.; sulphur, 0·045 per cent.; phosphorus, 0·052 per cent.; manganese, 0·33 per cent.; silicon, practically absent.



TRACK RAILS.

The rails are of the shape shown in the cross-section herewith, weighing 85 lbs. per yard, and measuring from 30 to 42 feet in length; the cross-sectional area of the rail is 8¼ square inches, and its resistivity 4·94 microhms per inch cube at 20° C.—7·3 times that of copper. The method of insulating and supporting the rail is shown in the figure; the insulators are of stoneware, and were supplied by Messrs.

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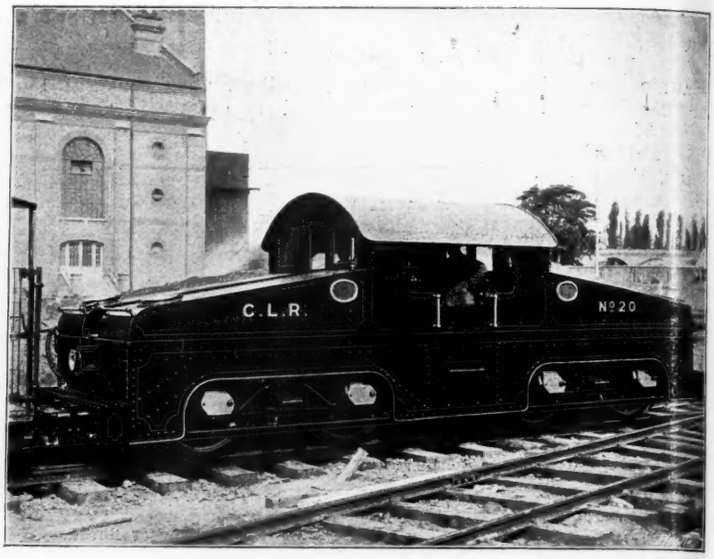
Berne & Co. They are spaced at distances of 7·5 feet apart, and as the total length of third rail is 12·6 miles, there are in all about 9,000 insulators.

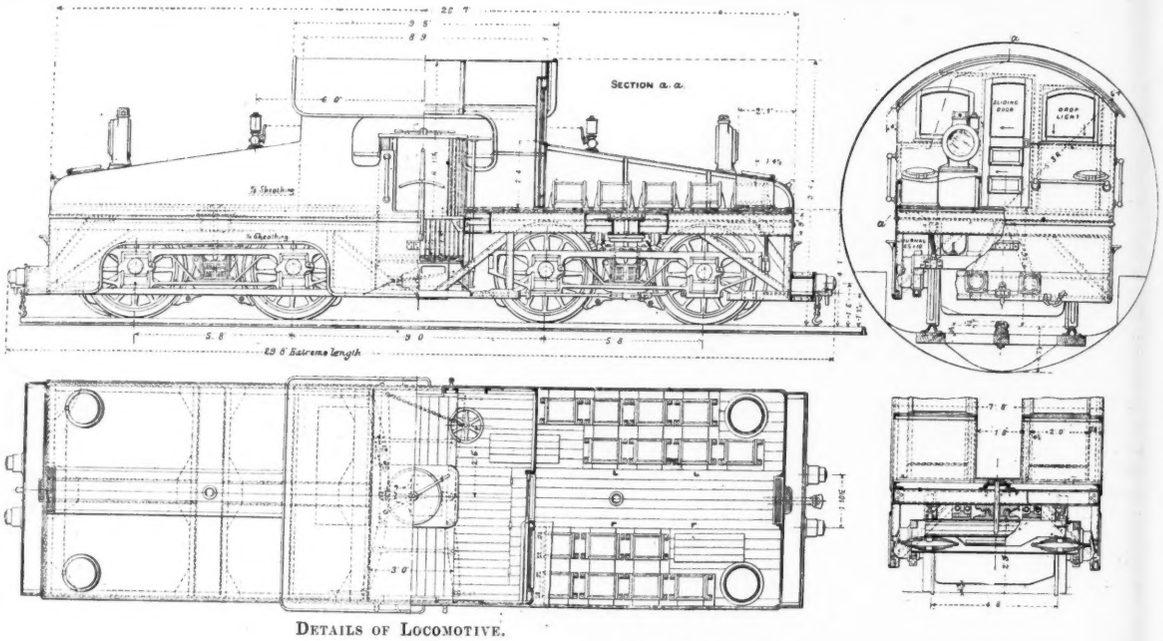
The joints are quadruply bonded with Crown bonds, having a total cross-section of 0·62 square inch.

The trains, which weigh about 150 tons loaded, are hauled by separate locomotives; each train consists of seven coaches, with seats for 336 passengers.

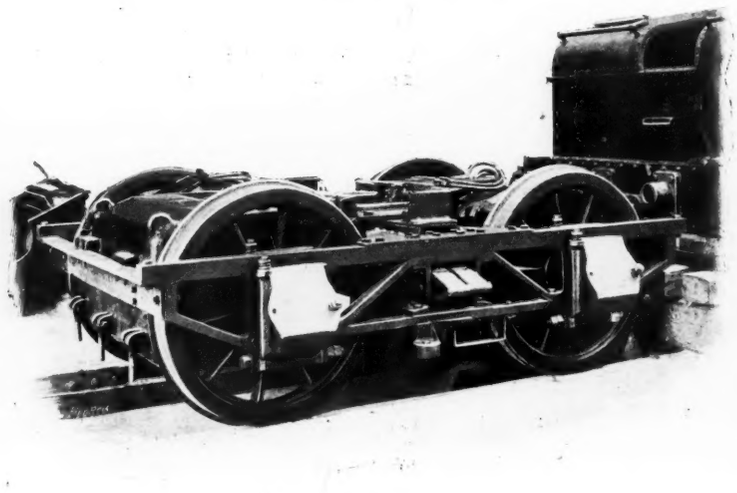
The coaches are arranged on the corridor principle, and, as will be gathered from our photograph of the interior of a train, the seats are arranged both longitudinally and cross-wise; the upholstering and fitting have been carried out in a most luxurious and artistic style, with every attention to the comfort of passengers, and we are glad to see—and to know by actual experience—that the lighting, produced by 8 16-C.P. lamps in each vehicle, is beyond reproach. The doors and gates are operated by ingenious latches and levers—the coaches being entered from the ends only. Some of the vehicles were constructed by the Ashbury



ELECTRIC LOCOMOTIVE.



DETAILS OF LOCOMOTIVE.



BOGIE OVER ERECTING PIT.

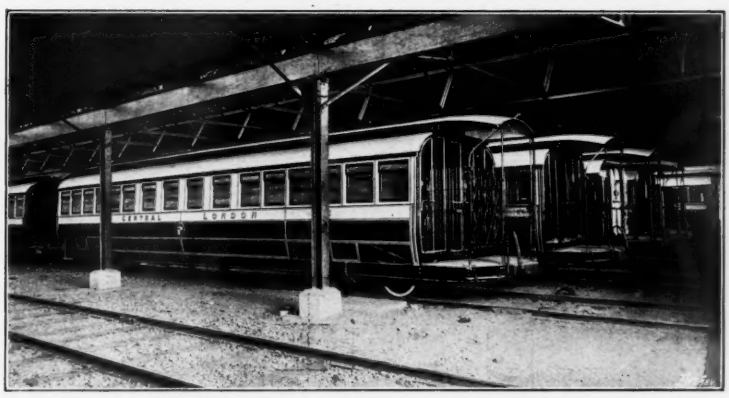
Railway Carriage and Iron Company, Limited, and the remainder by the Brush Electrical Engineering Company, Limited.

The locomotives are of the type shown in our photograph, consisting of a steel girder framework mounted on two four-wheel bogie trucks; the length over the body is 26 feet 7 inches, over the buffers about 30 feet, and the width 7 feet 8 inches. While the extreme length of the wheel base is 20 feet 4 inches, the distance between the wheel centres of each truck is only 5 feet 8 inches, so that the locomotive can take sharp curves without difficulty. The wheels are 42 inches diameter, and are direct driven by four motors, one on each axle, rated at 117 H.P. each. The frames of the motors are mounted rigidly on the bogies, without springs.

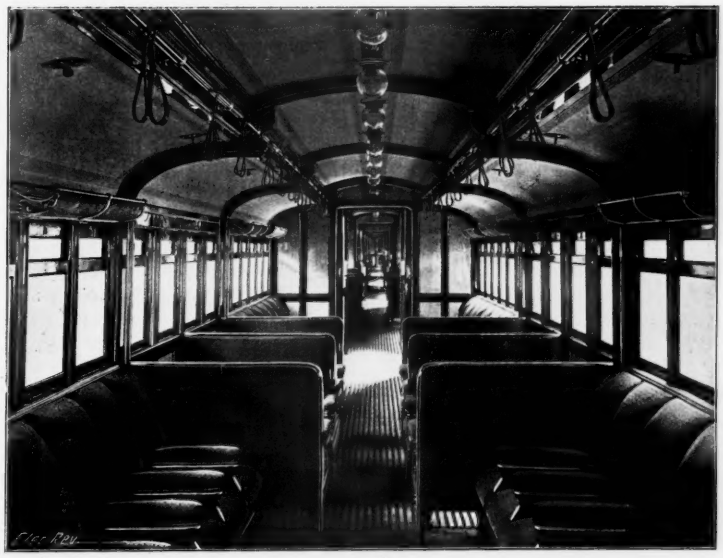
Above the motors is a wooden floor, extending from end to end of the locomotive; upon the centre of this is fixed the controller, protected by a driver's cab of iron plate. The ends of the locomotive are similarly covered in with sloping iron roofs, which afford protection to the regulating resistances. The look-out windows are clear above these covers, allowing of an excellent view being obtained in either direction.

The working current is collected from the third rail by means of two heavy cast-iron shoes or plates, which are mounted in such a way as to run freely on the third rail, while at the same time they are not able to come in contact with the track rails. To accomplish this is by no means so easy a matter as might be supposed, for the third rail stands only 1½ inch above the level of the running rails, and at cross-over roads the opposite poles are brought very near together. At these points the third rail is bent so as to run along for a short distance on each side of the crossing rail, so that the shoe receives support from both sides until it is safely over the risk.

From the shoes the current passes through a massive automatic circuit breaker and switch, which is fixed to the roof of the cab, to the controller, then to the motors, and finally to the track rails *viâ* the wheels. The measuring instruments — a Weston ammeter and voltmeter, and pressure gauge for brakes — are in duplicate, one set at each end of the cab, so that they are in clear view of the driver, no matter in which direction the train is going. The pressure gauge mentioned above is connected with the air reservoirs of a Westinghouse brake outfit, which is actuated by a small series motor driving a set of air compressor pumps; the motor is started and stopped automatically, maintaining a constant pressure of 80 lbs. per square inch in the reservoirs. The latter are placed with the resistances under the covered ends, and in addition to working the brakes, they supply air for the whistles.



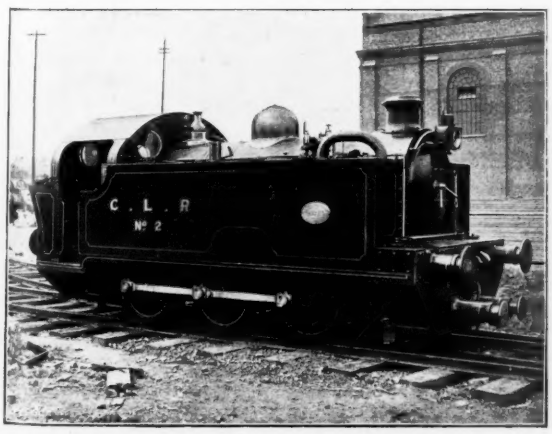
Interior of Car Shed.



Interior of Train.

The total weight of the locomotive is 97,000 lbs.; it is capable of exerting a draw-bar pull of over 30,000 lbs., and is designed to maintain an average speed of 14 miles per hour over the whole of the route.

At present the third rail equipment ends at the top of the incline leading up to the surface at Shepherd's Bush; the trains and electric locomotives are therefore handled in the yards by means of two steam engines made by the Hunslet Engine Co., one of which we illustrate. These little locomotives strike one as remarkably neat, compact, and handy machines, and work in perfect harmony with their rivals.



Steam Tank Locomotive.

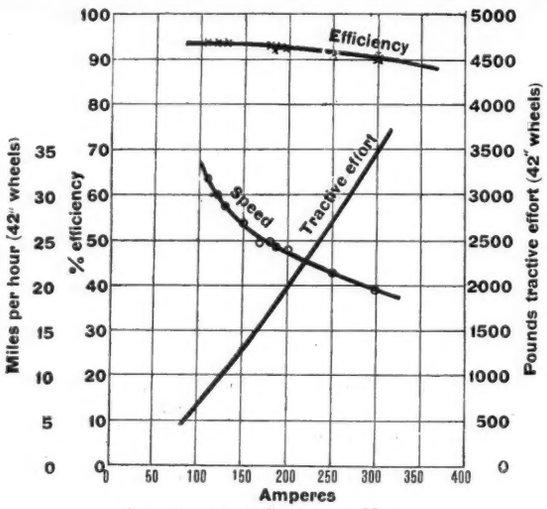
The construction and dimensions of the locomotives and their running position with regard to the tunnel are shown in the figures which we reproduce. We give also a photograph of one of the bogies of the last locomotive built; this was not quite completed, the lower halves of the motors not having been fixed in place. The bogie is shown in position over the erecting pit for this purpose, with the cover, which is rivetted up in one piece with the frame, close by in readiness to be fitted in position.

The whole of the locomotives were assembled in the workshops at Shepherd's Bush, which are equipped with hydraulic presses, lathes, drills, &c, for this purpose and for carrying out repairs.

One of our views shows the locomotive shed, which is capable of housing 24 locomotives in 6 bays, while another photograph shows the interior of one of the car sheds. The latter consist of 12 bays, each 360 feet in length, and providing accommodation for a complete train; 22 trains are required to maintain the schedule service, and are permanently coupled up. A row of sheds is also provided, in which the cars may be washed and cleansed.

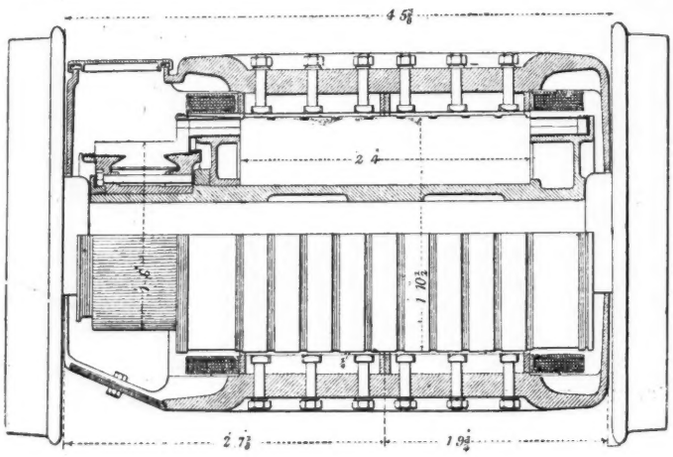
We pass now to a more detailed description of the motors. These are shown in elevation and section in our illustrations; it will be seen that they are of the series-wound four-pole ironclad type, with the frame divided diagonally. The armatures are built up on brass sleeves, which are forced on the axles after delivery at Shepherd's Bush. To suit the

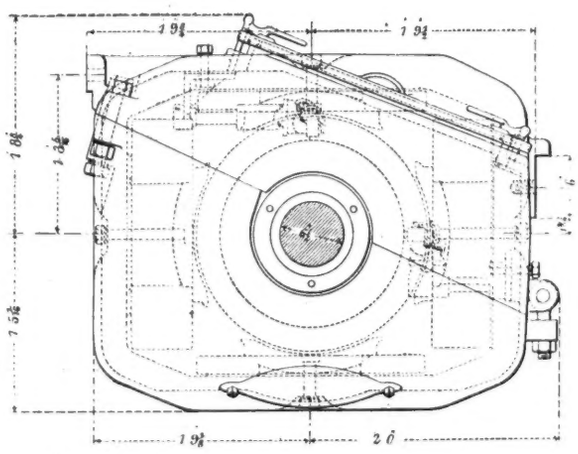
exigencies of space, the upper and lower pole pieces—or magnet cores—carry coils of small dimensions, the greater part of the winding being concentrated on the cores at the side.



CHARACTERISTIC CURVES OF MOTOR.

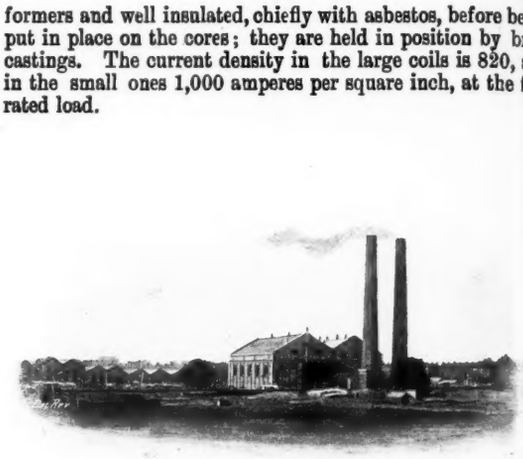
The frame of the motor is of soft cast-steel, to which the laminated magnet cores are bolted; the division is so arranged that the lower half can be dropped, in order to expose the armature for inspection.





END ELEVATION AND SECTION OF MOTOR.

The large coils consist of 76 turns each, of copper strip, 2·125 inches × 0·11 inch, while the smaller coils comprise 15 turns, 0·875 inch × 0·22 inch. The coils are wound on formers and well insulated, chiefly with asbestos, before being put in place on the cores; they are held in position by brass castings. The current density in the large coils is 820, and in the small ones 1,000 amperes per square inch, at the full rated load.



VIEW OF DEPÔT.

The yoke and poles have a mean cross-section of 240 square inches, and work at an induction density of about 102,000 lines per square inch at full load; the weight of the frame, including the winding, is 9,000 lbs.

The armature core is built up of punched steel discs, mounted directly on the brass sleeve above-mentioned; there are 61 slots, each 1·73 inches × 0·52 inch, with six conductors per slot. The winding is of the series drum type, consisting of 366 bars, 0·6 inch × 0·1 inch, so that there are 183 in series between the brushes; the bars are held in place by hickory strips and steel binding wire.

The field poles are bored out to a diameter of $23\frac{1}{16}$ inches, while the armature core is $22\frac{1}{2}$ inches diameter; the air gap is thus $\frac{1}{4}$ inch below the armature, and $\frac{5}{16}$ inch above, to allow for wear in the bearings.

The commutator, which is 19 inches diameter × 8 inches long, consists of 183 segments, held in place by steel cones mounted direct on the brass sleeve, and insulated with mica. There are two sets of carbon brushes, each set consisting of four.

The total weight of the armature, without the axle, is 3,000 lbs.; the complete motor weighs 12,000 lbs.

The efficiency, speed and tractive effort of one of these motors are shown in the diagram herewith. The efficiency was determined at the speeds indicated on the speed curve, while the tractive effort is, of course, independent of speed. The value attained for the efficiency at full speed and load—over 93 per cent.—must be regarded as highly satisfactory.

(*To be concluded.*)

THE NEW WORKS OF THE ENGLISH ELECTRIC MANUFACTURING COMPANY, LIMITED.

THE formal opening of the magnificent factory at Preston, which took place last week, marked an epoch in the history of electric traction in this country.

For the last ten years we have watched with more or less interest, the extraordinary development of the industry in America, and to a somewhat less extent on the Continent; meanwhile, although attempts were not wanting on the part of our engineers and financiers to emulate the example of their foreign rivals, and to carry out electric tramway schemes in various places, so keen was the popular prejudice, born of ignorance

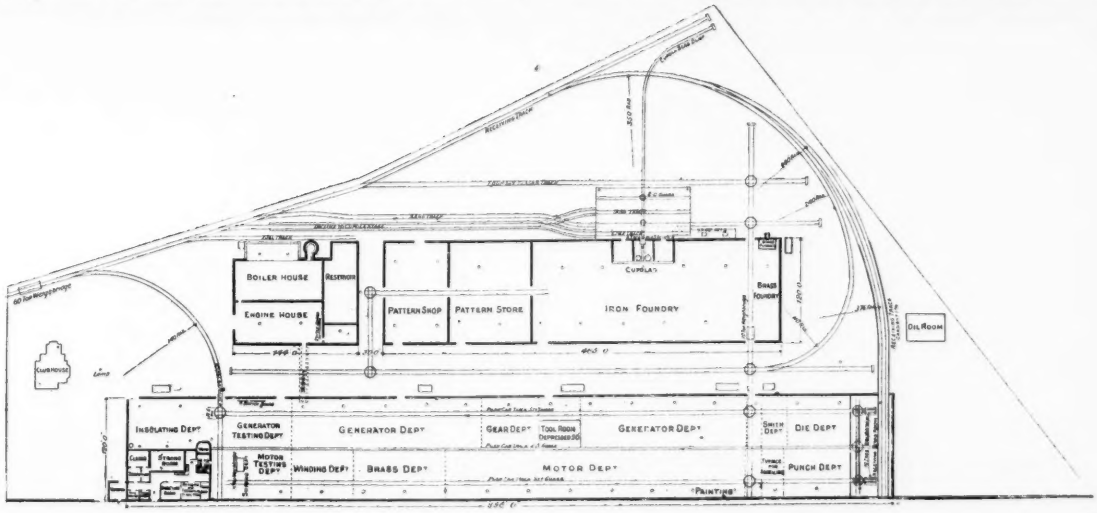
and conservatism, against the innovation, and so adverse the legislation dealing with such matters, that for long the industry remained almost at a standstill. Unfortunately, although it is impossible to believe that British manufacturers did not foresee the enormous importance of the coming "boom," they nevertheless made no preparations to cope with the demand, they acquired but little experience in the subject, and now they find themselves in the position of lookers-on, unable to secure even a tithe of the home trade, or any at all of the foreign business,

General View of Works.

while order after order goes across the Atlantic to the huge American firms which have laid themselves out to meet the immense demand. Not only is this true of the electrical apparatus, but even the steam engines, in the manufacture of which we look upon ourselves as *facile princeps*, are imported also! But the latter condition, beyond all doubt, is not due to any inferiority in our engines, which are fully capable of coping with the most onerous requirements.

At the present moment it is probably the fact that the development of electric traction is proceeding in this country more rapidly than in any other country in the world. Nearly all our great cities have in hand electric tramway projects of the first importance, lesser towns and urban districts—many of which have already carried out similar undertakings of no small magnitude—are busily laying down and extending their systems, and several private companies, specially formed for the purpose, are constructing and equipping tramways with the utmost expedition. At such a time we hail with keenest pleasure the inauguration of a wholly British factory devoted primarily to electric traction, and which, in point of equipment and organisation, will challenge comparison with any similar undertaking in existence. Nor will the new works be called upon to establish their position in the trade by tedious and hard-fought steps; on the contrary, they commence operations with orders already in hand to an extent that will tax their utmost capacity for a year to come.

Before commencing the description of the works, it may be well to explain, in brief, their origin. Our readers will remember that about two years ago the Electric Railway and Tramway Carriage Works were laid down at Preston on a site near the Docks, by a group of far-seeing gentlemen interested in tramway working, in anticipation of the enormous demand which, as we have seen, has justified their foresight. These works were equipped on the most modern lines, under the guidance and management of American experts of the highest standing; the excellent results obtained, as regards both the quality and quantity of the work turned out, decided the proprietors to extend their operations, to include the manufacture of the whole of the electrical equipment also, following on the same lines. It so happened that just at this time the Walker Company of America became amalgamated with the Westinghouse Company, and the managing director of the former company, Mr. S. H. Short, decided to throw in his lot with the nascent British organisation. Of Mr. Short's previous record in electric traction, it is hardly necessary to speak; associated with the industry from its very birth, his reputation has grown with it to a world-wide extent as an engineer and inventor of the first rank.



Plan of Works.

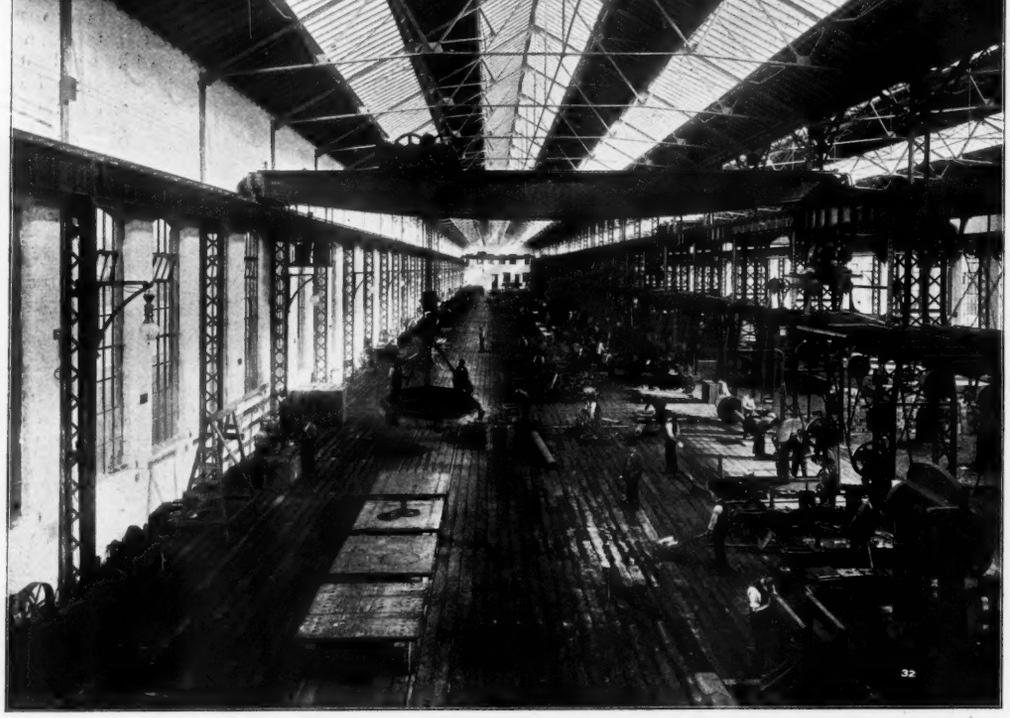
An agreement was made with Mr. Short, by which the design and management of the new works were placed entirely in his hands as technical director; no time was lost in preparing plans and placing orders, and on June 14th, 1899, the foundations of the buildings were commenced. On June 14th, 1900, the works were in full swing. The achievement constitutes an International record in point of time, and affords an excellent criterion of the spirit in which the company intends to pursue its future undertakings.

Drill Presses and Vertical Mills.

The site of the works consists of 10 acres of level ground, conveniently situated between the Preston Docks and the Carriage Works. The position of the works is peculiarly advantageous, being in the heart of the coal and iron districts, with facilities for transport both by water and by two main lines of railway, and being adjacent to the works in which the car bodies and trucks are manufactured—the latter a unique condition.

entrance; from this point diverge the various tracks seen in the plan. The receiving track curves round to the north end of the machine shop, which it enters on a low level, so that the platforms of the trucks are level with the floor of the shop. The traffic in the yards, and between them and the neighbouring Carriage Works, is carried on by means of electric locomotives; sidings from the London and North-Western and the Lancashire and Yorkshire Railways, and the Preston Corporation Docks, are in connection with the works.

Turning now to the buildings, the machine shop is by far the most important, being no less than 900 feet in length, and 120 feet wide; the height is 35 feet in the clear, with 25 feet head room under the cranes. The building is divided into two bays by a line of double lattice stanchions from end to end, which support the roof and crane girders, and carry the line shafting between them.



Machine Shop.—East Bay.

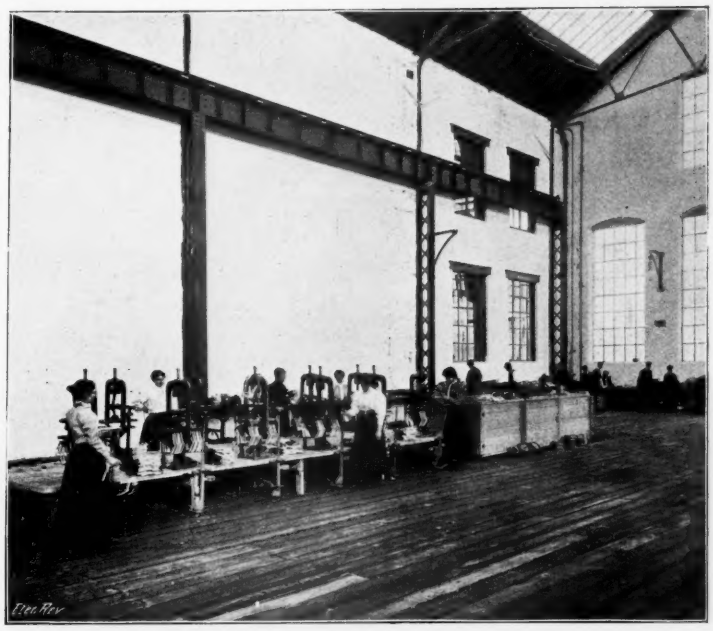
The buildings, which, excepting the offices, are one story high, cover 5 acres; they are of the American steel frame type, and of massive construction. From our plan it will be seen that the chief structures are the machine shop and offices, foundry and pattern shop, and power house.

All goods pass over an 80-ton weighbridge at the railway

Our illustrations include a general view of each of the enormous bays.

In laying out the works, Mr. Short devoted the greatest attention to the handling of materials and apparatus in their passage through the shops, with the special object of, as far as possible, avoiding confusion and loss of time. The raw

materials are received at one end of the building, and pass through successive operations, while travelling always in the same direction, until they finally arrive at the other end, completed, tested and ready for despatch. For this purpose a push-car track is laid along each bay, as well as an extra track running between the stanchions in the centre of the building. Further, there are two powerful electric cranes in each bay; these are provided with lifting electro-magnets under the control of the crane operator, who is thereby enabled to handle all steel and iron parts without assistance. Thus there are ample means for moving materials about the shop in all directions, while all the departments are provided with jib cranes and pneumatic hoists for placing work in the tools. For the last-mentioned purpose compressed air at 100 lbs. per square inch pressure is supplied to all parts of the works, serving also to operate pneumatic hammers and drills.



Corner of Armature Winding Shop.

Needless to say, electric driving is employed throughout the works. Each of the large tools is provided with a separate motor, while the centre line shaft drives the smaller tools by belting. The problem of finding the best degree of sub-division of power in this case has been investigated with the greatest care, with the result that an entirely new system has been devised, as follows: — The centre line shaft, which is 800 feet in length, is divided into eight sections, each of which passes through the armature of a 50-H.P. motor, and can be coupled therewith by means of a clutch; each section can be driven separately by its own motor, or the sections can be coupled up as desired and driven by any one or more of the motors. Moreover, the same shaft serves the small machine tools in *both* of the bays, between which it is placed, a novel arrangement which obviously tends to improve the load factor of the shafting; besides, the efficiency is increased, owing to the use of large motors, and the frictional loss is of the smallest.

Machine Shop: West Bay.

The two great bays are set apart, one for the manufacture

All goods pass over an 80-ton weighbridge at the railway

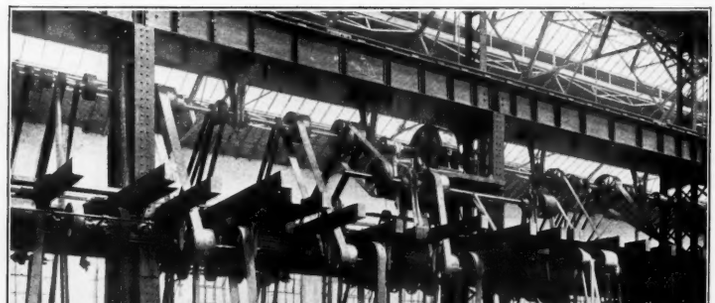
as possible, avoiding confusion and loss of time. The raw

of traction motors and equipments, the other for large generators, rotary converters, &c. Starting from the north end of the building, we first find the receiving and store rooms. These are provided with weigh-bridges, and are equipped with suitable receptacles for the various materials used in the works. The electric cranes are used for unloading goods from the trucks and distributing them to their various compartments.

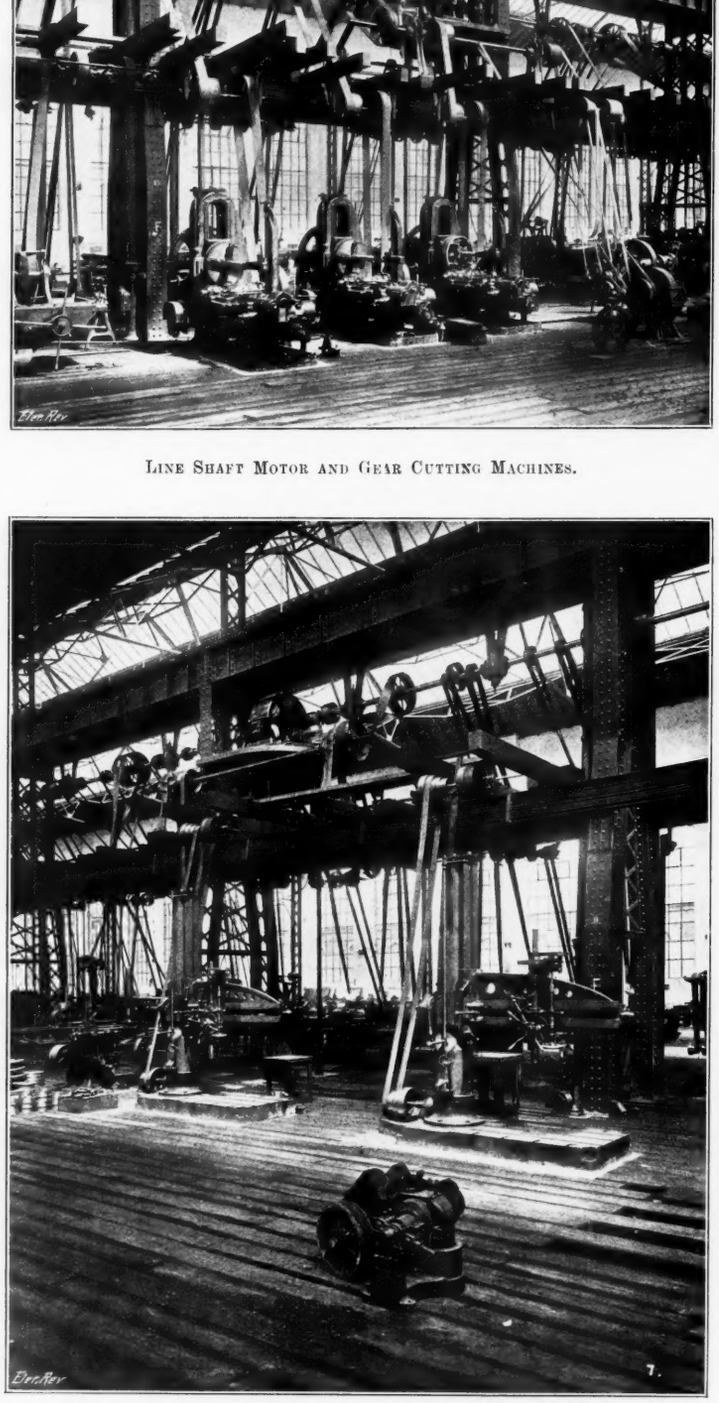
Leaving the store room, we come to the punch and die departments, in which the steel lamin æ for armature and field magnet cores are punched out of sheet by automatic machines of the latest pattern. The adjoining smith department is equipped with power hammers for forming the steel dies, which are afterwards hardened and tempered in this shop.

Other apparatus in the smithy comprise lathes, grinders, shaping tools, and drill presses. The grinders are specially interesting, being provided with two movements; the work is traversed to and fro, while the large grinding cylinders, running at a high speed, are moved axially at right angles to the motion of the work, so as to ensure a perfectly flat and true surface being imparted to the dies.

Next door to the smithy is an annealing room; here the armature discs are packed in iron cases, covered with sand to exclude air, and placed in ovens, to be heated to a dull red, and then gradually cooled. After annealing they are passed to painting machines, which apply to them an exceedingly thin layer of varnish, and drop them on a chain conveyor. The latter carries them through a drying oven and delivers them in the assembling department.



Line Shaft Motor and Gear Cutting Machines.



Radial Drill Presses.

Next in order is the railway track by which the castings of motor and generator frames are brought from the foundry to the respective departments through which they are to pass. The motor castings are first placed on a vertical milling machine, and the two halves faced so as to form a perfect magnetic joint. The next process is to drill all the holes on a radial drill press. The castings are now bolted together and taken to the horizontal boring mills, in which the armature and axle bearings are finished and the frames bored out to receive the magnet cores. After this operation the completed frames pass on to the motor assembling department. The lathes for turning the motor shafts, and special grinders for truing the armature shaft bearings come next, followed by turret lathes, in which the armature and lathes, commutator heads, and bearing shells are machined.

The brass-working department is the last of the machine shops on the motor side, including lathes, planers, shapers, milling machines, and various special tools; here the commutators and brush-holders, controllers, rheostats and trolleys are made.

Beyond the brass department is the field magnet winding department for both generators and motors; in this shop the magnet coils are wound, insulated and baked, and the armature coils are placed on the motor armature cores. The latter coils are prepared in a separate room at the extreme south end of the generator bay; here the coils are wound by machinery, insulated with mica, paper, and cotton braiding, then dried, dipped into special varnish and baked. After this they are pressed into the precise shape required for interchangeability. The mica rings and tubes for commutator insulation are also made in this room, being moulded under great pressure whilst hot; the presses for this purpose are heated by steam pipes from the boiler house. As will be seen in our illustration, most of

the winding, insulating, and moulding in this department, is done by girls; the total separation of this delicate work from the main machine shop ensures freedom from injury to the insulation by metal particles, &c.

A very fine group of special automatic gear cutting tools of the highest class is shown in another of our views.

(To be concluded.)

ELECTRIC TRACTION NOTES.

(*Continued from page* 1054.)

Portsmouth.—At a Council meeting on the 14th inst. the Tramways Committee submitted a suggested basis of agreement for the settlement of the dispute between the tramways companies and the Corporation, in reference to the transfer to the latter of the lines under the provisions of an Act passed last year. Should the Corporation require to proceed with their work, the company is to hand over at any time after October 1st either or all of the sections, and the remainder of the lines, &c., on December 31st. The omnibuses, hearses and carriages, as to which litigation had been commenced, to be retained by the companies, and no claim whatever to be made by them on the Corporation for unexpired profits in respect of the same. The arbitration to determine the amount to be paid by the Corporation for the undertaking, and to be proceeded with as soon as can be arranged. Sir F. Bramwell has been appointed arbitrator. The vendors claimed £10,000 as special compensation, but it has been arranged that in respect to this claim the arbitrator shall include in his award the sum of £2,500. Mr. H. Kimber, chairman of the Tramways Committee, in moving that the proposed agreement be ratified, said that if they went on with the legal proceedings and won, the costs would probably be considerably more than the amount now recommended to be paid. If the case went on they might be delayed 12 or 18 months in taking over the tramways and introducing electric traction and a better and quicker service. After a little discussion the several clauses of the proposed agreement were ratified *und voce*. On the following day the tramways directors approved of the agreement.

Rhondda Valley.—The Urban District Council for the great coal valleys of the Rhondda have been considering the matter of electric traction, and a conference has been arranged to take place with the British Electric Traction Company in order to see if an amicable settlement can be come to with regard to the question of road widening. The suggested light railway scheme would, according to the demands of the Council, entail an outlay of £14,000, and the British Electric Traction Company have advised the Council that this is very much in excess of what they can afford. On the other hand, from what has transpired, the Council does not intend spending anything in regard to the widening. The Council have also discussed the advisability of having a provisional order for the electric lighting of the district. It is considered that if the proposal will pay Pontypridd it ought also to pay the Rhondda, as the two coal centres impinge the one upon the other. There was a consensus of opinion that it would be wise to get an order in any case, and it was finally decided to apply for the order next session.

Smethwick.—The Town Council, in accordance with the advice of an expert, has decided to apply to Parliament for power to purchase the tramways within the borough, and for the construction and working of such other tramways in connection therewith as may be agreed upon.

Surbiton.—The British Electric Traction Company have informed the Tramways Committee that they have purchased the rights of Greenwood & Batley in the light railway scheme, and have given an amended notice of a much more comprehensive scheme. The Committee will oppose, and will proceed with their own tramway scheme in Parliament. A committee is reporting further upon the subject of electric lighting.

Warrington and Northwich.—An inquiry was held on Thursday, June 14th, by the Earl of Jersey and Colonel Boughey as to the above scheme. The Eastern branch only was proceeded with, but though the scheme was strongly supported by Councils, companies, traders and residents all along the route, it was dismissed on a legal point, viz., that no compulsory powers had been obtained to acquire land. It is the intention of the engineer to amend this point and again present the scheme. The Western branch still stands over, as the days of grace for objections had not elapsed before the date fixed for the inquiry.

TELEGRAPH AND TELEPHONE NOTES.

Bradford Telephones.—At a meeting held on May 25th of the sub-committee appointed to consider the question of telephones, a deputation from the Bradford Chamber of Commerce attended by invitation. After the chairman had explained to the deputation the present state of affairs between the Corporation and the Telephone Company, the subject of the telephone service was discussed generally. Instructions were given for the members of the deputation and of the sub-committee to be supplied with a copy of the city surveyor's report as to telephones, and of information obtained from Glasgow with regard to the Municipal Telephone Exchange which has been installed in that city. The deputation undertook to bring before their Chamber the question of the proposed municipalisation of the telephone service, and promised to communicate to the town clerk the views of the Chamber of Commerce on the subject. At a subsequent meeting of the committee a letter was received from the Bradford Chamber of Commerce, stating that the Council of the Chamber had considered the question of the proposed establishment of a municipal telephone service in the city, and that they could not for the present recommend the Corporation to establish such a service, but deemed it advisable to await the results of the municipal service which was now being established in Glasgow. The sub-committee thereupon considered the matter, and resolved that the Council be recommended to enter into a new agreement with the National Telephone Company, Limited, for wayleave facilities, such agreement being subject, among other provisions, to determination on six months' notice.

Brighton Telephones.—A Committee has submitted an elaborate report to the Town Council, embodying detailed estimates of income and expenditure by Mr. A. R. Bennett, telephone engineer, a letter from the National Telephone Company applying for permission to lay underground wires and to improve their system, and the observations of the Committee on the whole subject. It is estimated that to establish a system for 2,000 subscribers would involve a capital expenditure of £43,280; that the annual working expenses would be £10,269 and the profit £1,200. The Committee ascertained that the National Telephone Company could not see their way clear to reducing their present rate of £10 per annum for a first connection and £8 10s. for each subsequent one, and, after full consideration, they recommend that application be made for a license to the Corporation for 25 years, the maximum charges to be £7 per annum for unlimited use of the system, or £3 10s., with a charge of 1d. for each call. The district to be embraced in the license would include not only Brighton and Hove, but the whole of the area between Rottingdean on the east and Shoreham on the west, and extending north as far as Burgess Hill.

Cable Communication with South America.—Mr. E. W. Parsons, secretary of the South American Cable Company, Limited, writes to the *Times* as follows:—

> At the present time, when so much attention is being called in Parliament and at public meetings to the monopoly of the allied telegraph companies who control telegraphic communication with the East, it will be of public interest to know that the existing state of telegraphic communication to the West (so far as South America is concerned) is also receiving attention at the hands of the Governments of the United States, of Brazil, and the Argentine Republic, and that these Governments have entered into a convention, which will come into force on July 1st next, by which the joint lines of their respective telegraph administrations will be available not only for telegraphic communication between the two countries, but also for the international service; this will practically open an alternate route to Buenos Ayres and the Plate.

Claim by the National Telephone Company.—At the Woolwich County Court on Wednesday last week, the National Telephone Company sued Mr. Barnet, of Beresford Square, to recover a year's rent of telephone between defendant's two shops. Defendant said the instruments were useless. The learned Judge said he could scarcely believe that the company would refuse to make the service effective, but as the company had taken the extreme step of disconnecting the service he did not think they could recover. He gave judgment for defendant, with leave to appeal.

Glasgow Telegraphs.—With reference to the difference existing between the Glasgow Corporation and the Post Office authorities regarding the route to be followed by the underground line of telegraph from Royal Exchange Court to Douglas Street, Mr. John Lindsay, interim town clerk, as representing the Corporation, and Mr. Brownlie, writer, on behalf of the Post Office authorities, appeared before Sheriff Berry on 18th inst. and debated the question. The question was ultimately settled by the Corporation agreeing, under protest, to withdraw their objections to the route recommended by the postal authorities.

Islington Vestry and the National Telephone Company.—The Works Committee reported at the last Vestry meeting that they had considered from time to time reports by the surveyor to the effect that the National Telephone Company had on several occasions placed overhead wires at spans exceeding 115 yards, the limits allowed by the bye-laws made by the London County Council in pursuance of the London Overhead Wires Act, 1891, without obtaining the permission of the Vestry to the erection of a longer span, and the statements required by the bye-laws to be furnished to the Vestry from time to time were often found to contain inaccurate information and were consequently unreliable. They therefore recommended that the solicitor be instructed to commence proceedings against the company in respect of the breaches of the bye-laws in two instances. The report was unanimously passed.

Portsmouth Telephones.—At a Town Council meeting last week, the Finance Committee reported that on an application from the National Telephone Company with regard to placing additional telephone lines underground, they had under consideration the question of providing a municipal telephone exchange, but, after fully considering the whole question, they were of opinion that it would be better to enter into an arrangement with the company under which the payment to be made by them for the privilege of underground wires being placed would be very considerably increased. The Committee recommended that an agreement similar to one which had been entered into between the Corporation of Edinburgh and the company be entered into by the Corporation of Portsmouth, providing for a minimum payment by the company of £227 10s. per

Next in order is the railway track by which the castings of motor and generator frames are brought from the foundry

the presses for this purpose are heated by steam pipes from the boiler house. As will be seen in our illustration, most of

annum, but omitting a limit of population contained in a provision in the Edinburgh agreement to the effect that, in the event of the company giving in any other town terms more favourable to the subscribers than those specified in the agreement, the Corporation should have the benefit and option of such terms in lieu of those specified. The agreement provides for the Corporation, at the request of the company, placing underground tubes or conduits at the expense of the latter, and an unlimited service, at an annual charge of £10 per instrument, or a fixed charge of £3 10s. per annum for each instrument, with a fee of 1d. per call, without any charge for messages received at such instrument. The annual payment to be made by the company is to be at the rate of 5s. per annum for each separate instrument used by subscribers to the company's exchange and 10s. per annum for each large junction box, but the minimum amount is to be, as stated, calculated on 800 instruments and 55 junction boxes, the proposed agreement to be without prejudice to the right of the Corporation to establish a telephone exchange hereafter, should it be thought desirable to do so. Alderman Scott Foster, in moving the adoption of the report, said if the Corporation started a municipal exchange, the Government would have the right in 1911 to take over the whole thing, and would not be compelled to take any of the plant or appliances then in use.—Mr. Dittman mentioned that Tunbridge Wells had received a license for 25 years. He moved, as an amendment:—"That the report be referred back, and that it be an instruction to the Finance Committee to obtain a report from an expert as to the cost of establishing a municipal telephone exchange." After a discussion, the amendment was carried by 23 to 17.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
West Indies:—		
Jamaica-Colon	... June 30, 1899 ...	...
Trinidad-Demerara (1871)	... May 11, 1900. ...	...
Mole St. Nicholas-Cape Haitien	... March 6, 1900 ...	...
Cayenne-Pinheiro	... Oct. 11, 1899 ...	...
Cayenne-Paramaribo ...	... Feb. 16, 1900 ...	...
Pará-Maranham	... March 1, 1900 ...	...
Ceará-Maranham	... Feb. 20, 1900 ...	...
Latakia-Cyprus	... June 20, 1899 ...	...
Tarifa-Tangier	... Jan. 2, 1900 ...	...
Landlines.		
South African:—		
Communication with Mafeking and beyond	... Oct. 13, 1899	... June 20, 1900
Communication beyond Laings Nek	... Nov. 7, 1899 ...	...
Chinese:—		
Tientsin-Pekin	... June 12, 1900 ...	...
Pekin-Kalgan	... June 14, 1900 ...	...
Tientsin-Shanghai ...	... June 16, 1900 ...	...
Tientsin-Newchang ...	... June 18, 1900 ...	...
Siberian:—		
Tschita-Blagowestchenck	... June 17, 1900	... June 18, 1900
Communication with all offices of Colombia beyond Buenaventura	... Feb. 22, 1900 ...	...
Communication "*vid* Hanekine" interrupted on Persian Territory	Feb. 24, 1900 ...	...
Ecuador landlines	... Mch. 13, 1897 ...	...
Brazilian landlines, south of Macaké	... Apl. 25, 1900 ...	...
Moulmein-Bangkok	... June 16, 1900	... June 18, 1900

Underground Telegraph Lines.—In the House of Commons on Monday, Mr. Hanbury, answering Sir John Leng, said the underground telegraph line from London to Birmingham met the demand for uninterrupted communication over that part of the country where destructive gales were most prevalent, but it was not at present found to be so generally useful as the overground line. The Postmaster-General could not at present contemplate its extension to the north.

Wireless Telegraphy.—The *Daily News* says that the London Fire Brigade has successfully applied the wireless telegraphic system to its methods of work. The street station on the top of Streatham Hill has been placed in communication with the horsed-escape station in Mitcham Lane.

Experiments in wireless telegraphy are being made from Ilfracombe to the Mumbles, a distance of about 21 miles, across the Bristol Channel. The experiments, says a Cardiff paper, are being conducted under the direction of experts from the staff of the Electrical and Engineering Department of the G.P.O., and are a continuation of the long series which have been carried on between Lavernock Point and Weston.

CONTRACTS OPEN AND CLOSED.

OPEN.

Belgium.—The Belgian State Railway authorities are at present inviting tenders for the supply and erection of the necessary plant and apparatus for the electric lighting of the railway stations and workshops at Chatelineau, Montigny, and Couillet. Particulars may be obtained from, and tenders are to be sent to, La Bourse, Brussels.

Blackpool.—July 23rd. The Corporation wants tenders for trolley poles, cables and trolley wire, boosters and switchboards, and storage battery. See "Official Notices" to-day.

Brussels.—September 19th. The Council of St. Jilles, lez Bruxelles, invites tenders for the installation and the commencement of supply upon a part of its territory. Conditions and plan for three francs at the office, No. 14, Parvis St. Jilles, St. Jilles.

Dudley.—June 30th. The Corporation wants tenders for condensers (barometric), pumps, cooling tower, &c., for the electricity works. See "Official Notices" June 15th.

Durban.—July 20th. The Corporation wants tenders for overhead equipment for (*a*) about 16 miles of single track, including poles, overhead trolley wire, distribution boxes; (*b*) 22 double-deck motor cars; (*c*) steam and electric generating plant, including three 250-KW. generators, boilers, condensers, cooling towers, switchboard, &c. See "Official Notices" May 18th and June 15th.

Edinburgh.—July 9th. The Corporation wants tenders for the supply of copper strip for electrical conductors. See "Official Notices" to-day.

Egypt.—July 1st. Tenders are being invited until July 1st by the harbour and lighthouse authorities at Alexandria for the supply and erection of the necessary plant and apparatus required for the electric lighting of the harbour of Port Said. Tenders are to be sent to L'Administration des Ports et Phares, Alexandria, whence particulars may be obtained.

France.—July 5th. Tenders are being invited until July 5th by the French Post and Telegraph authorities in Paris, for the supply of 135 tons of galvanised iron wire, 4 mm. diameter, and 12 tons of ditto, 1 mm. diameter. Tenders are to be sent to Le Sous-Secretariat d'Etat des Postes et des Telegraphes, 103, Rue de Grenelle, Paris, whence particulars may be obtained.

Italy.—July 14th. The Municipal authorities of Maddalena (Sardegna), are inviting projects and tenders until July 14th, for the electric lighting of the public streets of the town. Particulars may be obtained from, and schemes and tenders are to be sent to, Il Municipio di Maddalena (Sardegna.)

London.—July 2nd. The Aron Electricity Meter Company is inviting tenders for the supply of a quantity of A.C. and D.C. large and small metal cases (about 2,500 in all). See "Official Notices" to-day.

London.—July 10th. The London County Council is prepared to receive tenders for the supply, within three months of the order being given, of about 70 arc lamp standards, required in connection with the electric light installation for the Victoria Embankment. Specification, form of tender, and other particulars at the engineer's department, County Hall, Spring Gardens, S.W., upon payment of the sum of £1.

Limerick.—July 4th. The Council wants tenders for cables, arc lamps, engines, dynamos, booster, balancer, switchboard, instruments and gas plant, for electric lighting. See "Official Notices" June 15th.

Manchester.—June 30th. The Tramways Committee wants tenders for the overhead equipment of three routes of tramways. See "Official Notices" June 15th.

Salford.—July 16th. The Corporation wants tenders for overhead equipment for the electric tramways, exclusive of the supply of poles, but inclusive of their erection. See "Official Notices" to-day.

South Shields.—July 14th. The Guardians want tenders for an electric light installation at the Union Workhouse, Harton, South Shields. See "Official Notices" to-day.

Spain.—July 7th. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Ambassador at Madrid, stating that tenders are invited by the Spanish Government, to be received not later than July 7th next, for the concession for an electric tramway from the Puerta de Hierro (Madrid) to Aravaco and Pozuelo. Some particulars may be examined on personal application at the Commercial Department of the Foreign Office between 11 a.m. and 5 p.m.

Spain.—July 10th. The municipal authorities of Calzada de Calatrava (province of Ciudad Real) are inviting tenders until July 10th for the concession for the electric lighting of the town during a period of 20 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Calzada de Calatrava (Ciudad Real).

Swansea.—July 5th. The Corporation invites tenders for main switchboard and instruments, and a battery of accumulators and accessories. See "Official Notices" to-day.

Tottenham.—July 2rd. The Council wants tenders for the supply of fire alarm posts and instruments, and a quantity of gas barrel. See "Official Notices" to-day.

Tunbridge Wells.—July 5th. The Corporation is inviting tenders for telephone cables, wires, and various apparatus required for the establishment of a municipal telephone exchange. See "Official Notices" to-day.

Warrington.—The Corporation wants tenders for the installation of electric light into the town hall, bank house, museum, and other public buildings. See "Official Notices" to-day.

Company, the subject of the telephone service was discussed gene- viding for a minimum payment by the company of £227 10s. per

CLOSED.

Bury.—Messrs. Crowther & Co., of Manchester, have obtained the contract for the electric lighting of the new post office at Bury, Lancashire, from the General Post Office, London.

King's Lynn.—The Corporation last week accepted the following tenders for electric lighting extension plant:—

(*a*) Two steam dynamos and one small motor generator, Messrs. Laurence Scott & Co., Limited, Norwich, for £3,498.
(*b*) Boiler, economiser, condenser, pump, &c., Messrs. Yates & Thom, Blackburn, for £2,375.
(*c*) Extensions to switchboard, Messrs. Lewis, Bayliss & Co., Wednesbury, for £206.
(*d*) Feeder mains, joint boxes and dynamo cables, Messrs. Callender's Cable and Construction Company, Limited, London, for £523.

Llandilo.—The District Council on Tuesday last gave the contract for the electric lighting of the town to Mr. Bertram Thomas at £2,415.

Leeds.—The Lighting Committee has accepted the tender of Messrs. Belliss & Morcom, Limited, of Birmingham, for the supply of two sets of electrical generating plant at £12,000.

London.—The Bermondsey Vestry on Monday opened the following tenders received for the supply and laying of cables and conduits in connection with the electric lighting station.

W. T. Glover & Co.	£8,018 4 8
The St. Helens Cable Company	8,109 16 8
Siemens Bros. & Co.	8,113 9 11
Callender's Cable & Construction Company	8,312 7 1
The Western Electric Company	8,219 0 0
The British Insulated Wire Company	8,643 15 10

The tenders were referred to the Electric Lighting Committee for consideration and report.

Wigan.—At the last meeting of the Borough Council it was decided to fix the corporate common seal to the following contracts in connection with the electric light and tramway undertaking:—

Messrs. Dick, Kerr & Co., Limited, for cars; Messrs. J. Glover & Co., for cables and pilot wire; Messrs. Askham Bros., for points, crossings, &c.; John Ross and the Manx Granite and Silicia Quarries Co., Limited, respectively for granite setts; Messrs. Thompson & Co., for iron and steel; Messrs. S. Marsden and Son, for bolts; Messrs. Taylor & Sayers, for castings; Messrs. J. Elwell, for corrugated iron; and Messrs. W. Winnard, for rebuilding river wall.

The seal was also affixed to the following agreements:—

(*a*) An agreement between F. W. Smith & Co., Limited, and the Corporation of Wigan, as to wiring of consumers' premises for electricity purposes on the deferred payment purchase system. (*b*) An agreement between the same parties as to free wiring of consumers' premises for electricity purposes.

FORTHCOMING EVENTS.

Friday, June 22nd.—At 5 p.m. Physical Society. "Notes on Gas Thermometry," by Dr. P. Chappuis; "A Comparison of Impure Platinum Thermometers," by Mr. H. M. Tory; "On the Law of Cailletet and Mathias and the Critical Density," by Prof. J. Young, F.R.S.

Municipal Electrical Association Convention at Leeds. Third day. (Saturday, business meeting.)

Saturday, June 23rd to July 4th.—Tramway and Light Railways Exhibition at the Agricultural Hall, London.

Tuesday, June 26th.—Institution of Electrical Engineers' conversazione. Reception by Prof. Perry and Mrs. Perry.

Thursday, July 5th.—At 8 p.m. The Röntgen Society. Annual general meeting at 20, Hanover Square. Presidential address by Mr. Wilson Noble.

NOTES.

Aluminium Transmission Lines.—*Engineering* says that experience with the aluminium electric transmission mains erected in Western America has proved quite satisfactory. For a given conductivity the aluminium is just half as heavy as copper, and five-eighths as strong. Breakages have been few, though some of the lines have suffered from wilful damage, the insulators being used as targets for gun practice, and wires have been maliciously thrown over the leads in a number of cases. The joints between successive lengths of wire are not soldered, as experience shows that such connections stand badly. By pushing the ends of the wires into an oval tube, and twisting the latter, a joint has, however, been obtained which is as strong and conducts as well as the solid wire. Owing to the fact that aluminium expands more by heat than copper, it is necessary in erecting a line to make a greater allowance for contraction in cold weather than usual.

Presentations.—Mr. Alfred H. Gibbings, who has recently retired from the service of the Bradford Corporation in the capacity of City electrical engineer, in order to commence a private practice in London and Bradford as a consulting electrical engineer, was on 13th inst. the recipient of a substantial testimonial, which had been subscribed to by about a hundred persons engaged in the electricity department. The presentation, which consisted of a keyless gold hunter watch for Mr. Gibbings, and an electro-plated fruit stand and a set of flower vases for Mrs. Gibbings, took place at the Valley Road Electricity Works.

Mr. J. J. England, who has just secured an improved position with the British Electric Traction Company, was entertained on Friday night, the 15th inst., by the Cork Tramway Company's staff at a farewell concert. An excellent programme was provided, and at the close of the meeting a presentation was made.

On Saturday last, 16th inst., Mr. J. A. Henderson (late foreman electrician on the electric lighting staff of Messrs. Croggon & Co., Limited), was presented by his former colleagues with a handsome token of their esteem and goodwill. Mr. Henderson is commencing business for himself as a wiring contractor.

The Fatality at Deptford.—The inquest into the cause of death of C. H. Golton, 17, at the Deptford station of the London Electric Supply Corporation, was held by Mr. E. N. Wood at Deptford last week. Evidence was produced to show that Golton had suffered from a weak heart. Dr. Russell, of Deptford, said that a post-mortem examination disclosed no mark, with the exception of a small bruise on the nose. Death was due to asphyxia, the cause of which he had not been able to ascertain. The appearance of the body did not exclude the possibility of death from an electric shock. People had died from such without having a mark. Other evidence was to the effect that the deceased met with the accident near the transformer platform in the main building, and some broken pieces of fuse tubes were lying on his body, and others were scattered around him. Dr. Russell, when recalled, said that the valves of the heart were diseased, and the action might have failed through a fall, from faintness. If he had received an electric shock of 2,500 volts, he would have expected to have found burns, which he did not. He did not think it was a case of death from heart disease. Evidence was also given by Dr. H. Lewis Jones, medical officer of the electrical department, St. Bartholomew's Hospital, who said that he had followed the question of death from electric shocks very closely for many years, and had never known a case of death from an electric shock, where the voltage was 2,500, without a burn, which was usually the distinguishing symptom of death by electricity. It was almost impossible to distinguish death from an electric shock and heart disease as the resemblance was so close. He was of opinion that deceased could not have come in contact with the conductor near where he was found without receiving a burn. He had examined the conductor, and could find no signs of anyone having come in contact with it. He had read Dr. Russell's report of the post-mortem examination, and the appearance of the body, as described by him, was consistent with death from heart disease. Mr. C. W. Partridge, chief engineer to the Corporation, said that the fuses found near deceased were not in use. The jury returned a verdict of "Death from asphyxia, caused by an electric shock," but one dissenting juryman explained that he did not consider the evidence sufficient to justify the verdict.

The Paris Exhibition.—The *Newspaper Owner* says that "The delay in getting the electric force into order at the Paris Exhibition is costing many exhibitors heavily. The New York *Times* had decided to publicly print their journal, and, at the same time, show the interior of a newspaper editorial office. Seven weeks have now passed, and, although there are a staff of 30 drawing full salaries, the machines have never budged."

Electric Organ.—The Battersea Vestry has, by 37 to 12, resolved to accept a tender for the supply of an electric organ to the Town Hall at an estimated cost of £1,912.

may be obtained from, and tenders are to be sent to, La Bourse, Brussels.

installation of electric light into the town hall, bank house, museum, and other public buildings. See "Official Notices" to-day.

Electric Pumping in Mining.—At the meeting of the Institution of Mining Engineers at the Geological Society's rooms, Piccadilly, last week, a discussion arose upon a paper by Mr. Emerson Bainbridge, M.P., dealing with electric underground pumping. Mr. Henry Hall, Her Majesty's inspector, said Mr. Bainbridge had said nothing of the dangers of sparking in pumping underground with electricity. There was no doubt that very great benefits would be derived from the use of electricity in mines, but there was this danger from sparks which would have to be guarded against. Mr. Sydney Walker said that some French Government experts had dealt with this matter, and had eliminated any fear of danger from sparks. Mr. John Gerrard, Her Majesty's inspector, said the use of electricity in mines was cheap, and very convenient, but he endorsed Mr. Hall's remarks about the dangers from sparks, which might have to be treated as open lights.

The Huddersfield Convention of the M.E.A.—The proceedings on Wednesday commenced at 10 o'clock in the Technical College by the Mayor of Huddersfield giving the members and visitors a hearty welcome. The first portion of the programme consisted in the distribution of Associates' prizes to Messrs. Lunn and Thompson by Mr. Mountain, and this was followed by the presidential address (an abstract of which we publish in another place), delivered to an audience numbering nearly 100. Mr. Alderman Richards, of Bedford, proposed a vote of thanks to Mr. Mountain for his address.

Mr. Alderman Potter, of Taunton, was then called upon to read his paper on "Means of Stimulating the Demand for an Electricity Supply," which he did by dilating on some of the points contained therein in a manner which was rather confusing to those who, unable to catch the speaker's words, were poring over the original paper at a far corner of the room. Had he condensed his remarks, there would have been some purpose in ringing the changes, but he would have saved time by reading the paper as it stood. Mr. H. Collings Bishop, of Wigan, followed with a delightfully brief abstract of his paper on the same subject. The discussion was opened by Mr. Faraday Proctor, whose method of delivery is not conducive to the listeners' chances of following him, and it was carried on by Mr. Wilmshurst, Mr. Newington (Edinburgh), Mr. Nesbit, of free wiring repute, Alderman Richards, whose rosy hopes with regard to Bedford were utterly wrecked owing to the rise in coal, Alderman Bruce, of Sunderland, Mr. Dutton Briant (Brighton), Mr. Edgcome, Mr. Chamen, and Councillor West (Coventry). Mr. Potter having briefly replied, the discussion closed. With few exceptions, the speakers introduced much irrelevant matter, and valuable time was lost, and the looked-for means of further stimulating the demand for electrical supply was not forthcoming.

Mr. C. S. Vesey Brown was next called upon, at 12.10, for his paper on "Electricity Supply for Small Towns." Mr. Brown briefly referred to certain points which he had raised, and Mr. Harris was asked to add his contribution to the same subject, but to the majority of the gathering he was quite inaudible. These papers are lengthily abstracted in our columns devoted to the proceedings of the M.E.A., and we have made a few editorial comments upon them on another page. The discussion was commenced at 12.25 by Mr. Edgcome, followed by Mr. Boot; Mr. Quin, who proposed a system of Dowson gas storage and refuse destructors; Mr. Fedden, Mr. Tremlett Carter, who denied that Dowson gas could be stored at all, and Mr. Collings Bishop, who advocated Dowson gas and gas engines if not more than 400 KW. is demanded. The discussion was disappointing in the extreme, the subject, like the towns, appearing too small for the prominent members to be troubled with; yet the matter is one of importance, and will have to be dealt with, preferably, perhaps, by private companies, as we have suggested elsewhere.

The authors having replied, the meeting adjourned at 1 o'clock to partake of the Corporation luncheon at the invitation of the chairman of the Electricity Committee. In the afternoon most of the members went to visit the Bradford Corporation electricity works and tramway system, while a few journeyed to the Huddersfield Central Station, and to the well-known works of Messrs. J. Hopkinson and Co., Limited, where they were shown through all the shops and initiated into the mysteries attending the manufacture of the boiler mountings and valves for which the Huddersfield firm is famous.

In the evening Mr. Joseph Hopkinson, chairman of Joseph Hopkinson & Co., Limited, invited members and visitors to dinner, and so the first day of the Convention ended. To read, learn, and inwardly digest four papers, and to discuss them with profit, is too much for a three hours' morning.

Halford's Gradient Railways.—The Halford system is peculiar. It consists of a railway track from which the cars are suspended, and it consists of sections which, though joined to each other end to end, are capable of being set at various inclinations, so that the cars run by gravity. Thus a car runs down an inclined section, passes the junction point to the next section, and causes a hydraulic ram to operate so as to lift the joint, whereupon the car continues to run by gravity down to the next joint. The essence of the invention, which we find described in *Feilden's Magazine*, is this inclination of the track. We do not dispute the possibility of success of the system. The idea is perfectly feasible. It would be easy to carry out, but we have not much of an opinion of the invention as a practical invention. We doubt whether speed could be great, because some time would be occupied in the raising operation. Each length or section is proposed to be ¼ mile, and the weight would be very great, and the stress for a rapid lift would also be great. At 60 miles per hour a ¼ mile is covered in 15 seconds. The period of lift would need to be very short indeed, and the machinery necessary would be most costly. Most of the inventors of such novelties overlook the time element. What may be excellent as seen as a model may not show to much advantage on a practical scale.

Newcastle-upon-Tyne Electric Supply.—The Bill of the Newcastle-upon-Tyne Electric Supply Company should have come before Mr. Brown's House of Commons Committee on Wednesday, but Mr. Rickards mentioned that an arrangement had been come to, and they would not trouble the Committee.

Appointments Vacant.—The Sunderland Corporation want for their tramways a chief engineering assistant (£180 per annum), a junior assistant (£90), and two motor men. The Sheffield Corporation wants an electrical engineer to act as outside superintendent in connection with the erection of tramway poles, line, &c. (£155). See "Official Notices" to-day.

An assistant electrical engineer is wanted for the Hampstead Vestry electricity works at £130 per annum. See "Official Notices" to-day.

Electrical Volunteers Wounded and Missing.—The first casualty which has been recorded in the Royal Engineers Electrical Engineer Corps is that of Second Lieutenant H. F. Bigge, who was severely wounded at Rhenoster River. Lieutenant Bigge is a son of Major-General Bigge. Six corporals in the Electrical Volunteers are reported as missing on 14th inst.

Marriage.—Mr. F. Thursfield, the electrical engineer to the Chester Corporation, was married to Miss Lilian Coombe, at Chester, on Tuesday last week. The employés of the electric light station presented Mr. Thursfield with a barometer.

Municipal Trading.—It may interest some of our readers to know that the Municipal *v.* Company Trading controversy has been discussed in the *Westminster Gazette* during the past few days. Mr. Donald defends municipalisation and Mr. D. H. Davies takes the opposite line.

Personal.—We learn with great regret that Mr. Frederick Bathurst is temporarily *hors de combat*, and we sincerely hope that his indisposition will not be prolonged. Mr. Bathurst, as most people in the electrical world know, has championed his conduit through thick and thin with an untiring energy which has excited the admiration of commercial men. Unfortunately, Mr. Bathurst's characteristic persistence and overwork, and the consequent worry, have hit him somewhat hard, so that to-day, under the advice of specialists, he is compelled to take a complete rest from all business matters for a time. His many friends will doubtless join with us in our expressions of sympathy with Mr. Bathurst in his enforced retirement from the front.

Mr. H. Bevan Swift informs us that he has resigned his position with Messrs. Ball Bros. & Bates, of Shaftesbury Avenue, and late of Holborn, to take up the post of electrical engineer to the Lighting Corporation, Limited, of 4, Bloomsbury Street, W.C.

The Brush Electrical Engineering Company have appointed Mr. Edward A. Leeson to be works manager at their Falcon Works, Loughborough, in succession to Mr. C. E. Hodgkin. After many years' experience in the design, construction and working of steam machinery with Messrs. R. and W. Hawthorn, Newcastle-on-Tyne, Mr. Leeson became successively works manager of Messrs. Hawthorn, Guppy & Co.'s, works at Naples, and of the branch works of Sir William Armstrong, Mitchell & Co., at Pozzuoli, Italy. He recently returned to this country to take up the position of works engineer with Messrs. Hawthorn, Leslie & Co, Newcastle-on-Tyne. Mr. Leeson's wide experience of steam engine construction, and of the high class workmanship associated with the names of the firms given above, will doubtless prove of great value to the Brush Electrical Engineering Company in connection with the increasingly large plants under design and construction at their Falcon Works for lighting, traction and power purposes.

Mr. H. Davidson, of the Leith Corporation Electricity Works, was the successful candidate for the post of shift engineer, recently vacant at the Blackburn Corporation electricity and tramway generating station.

Mr. Arthur Ellis, electrical engineer to the Bolton Corporation, has been appointed electric tramways engineer to the Cardiff Corporation.

Mr. David Robertson, jun., B.Sc., who was for some years assistant to Prof. Jamieson at the Glasgow and West of Scotland Technical College, is about to take up his duties as lecturer in electrical engineering at the Bradford Municipal Technical College.

Mr. E. W. Dunston has been appointed borough electrical engineer at Whitehaven in succession to Mr. J. Gray Scott, who takes up duties shortly in a similar capacity at Leith. Mr. Dunton was for some three years assistant to Mr. Mountain at Huddersfield, and subsequently joined the staff of Hampstead Vestry electricity works as assistant to Mr. Cottam.

Mr. A. W. Money, late chief electrical engineer to Earl's Court Exhibition Company, has been appointed resident engineer to the Aberystwyth and Chiswick Electricity Supply Corporation.

The Society of Arts Albert Medal.—This medal for the present year has, with the approval of His Royal Highness the Prince of Wales, President of the Society, been awarded to Mr. Henry Wilde, F.R.S., "For the discovery and practical demonstration of the indefinite increase of the magnetic and electric forces from quantities indefinitely small." This principle is the one on which the invention of the modern dynamo machine is based, and is employed in all modern dynamos.

NEW COMPANIES REGISTERED.

Egerton & Co Limited (66,172).—This company was registered on June 8th, with a capital of £2,000 in £1 shares, to carry on the business of electrical engineers, electricians, engineers, contractors, suppliers of electricity, manufacturers of electrical apparatus and appliances, &c. The first subscribers (each with one share) are:—C. J. Watts, 13, Fairfield Road, N., manufacturer; W. J. Johnson, 29, Budge Row, E.C., clerk; G. S. Roberts, 29, Budge Row, E.C., clerk; E. T. Carden, 3, Crosby Square, E.C., chartered accountant; F. W. Watts, Stock Exchange, E.C., stock jobber; W. A. Carden, Fennain, Bexley, Kent, distiller; and A. J. Carden, Lea Valley Distillery, Stratford, E., distiller. Registered without articles of association.

Mangano Electric Process, Limited (66,237).—This company was registered on June 15th, with a capital of £50,000 in £1 shares, to acquire the rights and interests of G. E. Bourgoin and H. Lavollay in a certain invention for the epuration and decoloration of sugar juices by mangano electric treatment, and to carry on the business of electrical engineers, electricians, suppliers of electricity, chemical manufacturers, &c. The first subscribers (each with one share) are:—F. Witting, 13, Princes Street, Cavandish Square, W., civil engineer; A. Holliope, 72, Bishopsgate Street, E.C., accountant; L. A. Price, 89, St. Paul's Road, N.W., clerk; E. F. Trone, 3, Great Winchester Street, E.C., accountant; G. F. Franks, 55, Wiesbaden Road, N.E., clerk; W. Bullock, 48, Louisville Road, S.W., engineer; and F. C. Bell, 104, Osborne Road, Forest Gate, accountant. The number of directors is not to be less than three nor more than seven. The subscribers are to appoint the first; qualification, £250; remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Indo-European Telegraph Company, Limited (3 953).—This company's annual return was filed on May 19th, when 17 000 shares were taken up out of a nominal capital of £450,000 in 18,000 shares of £25 each. The full amount has been called up on each share, resulting in the receipt of £425,000.

W. T. Henley's Telegraph Works Company, Limited (13,795).—This company's annual return was filed on March 21st, when the entire capital of £300,000 in £5 shares (30,000 preference) had been taken up and paid in full.

Brompton and Kensington Electricity Supply Company, Limited (25,913).—This company's annual return was filed on June 2nd, when 19,661 ordinary and 12,000 preference shares were taken up out of a nominal capital of £199,500 in 27,900 ordinary and 12,000 shares of £5 each; £5 per share has been called up on 18,661 ordinary and 12,000 preference shares, resulting in the receipt of £153,305; £5,000 is considered as paid on the remaining 1,000 ordinary shares.

Western Telegraph Company, Limited (6,886).—This company's annual return was filed on May 30th, when 207,930 shares were taken up out of a capital of £2,500,000 in £10 shares. £10 per share has been called upon 130,000, resulting in the receipt of £1,300,000; £779,300 is considered as paid on the remainder.

New General Traction Company, Limited (47,321).—This company's annual return was filed on May 30th, when the entire capital of £370,000 in 50,000 preference and 24,000 ordinary shares of £5 each had been taken up. £250,000 has been paid on the preference shares, and £120,000 is considered as paid on the ordinary.

West Coast of America Telegraph Company, Limited (52,114).—This company's annual return was filed on May 29th, when 45,008 shares were taken up out of a nominal capital of £132,520 in 53,008 shares of £2 10s. each. £2 10s. per share has been called up on eight shares, resulting in the receipt of £20. 45,000 shares are considered as fully paid.

Oriental Telephone and Electric Company, Limited (40,691).—This company's annual return was filed on May 14th, when 171,504 shares were taken up out of a nominal capital of £200,000 in £1 shares; £1 per share has been called up and paid on seven, the remaining 171,497 being considered as fully paid.

SUPPLY STATION ACCOUNTS.

Islington Vestry Electricity Accounts.

The accounts of the Islington Vestry electric lighting undertaking show that the business is being extended in all directions, but that, owing to the withholding by the London County Council of consent to borrow money required for mains extensions, the capital expenditure on machinery is, so far as 1899 was concerned, not yet yielding its proper return. Thus we find in the accounts a remark that, of the capital expenditure during 1899, a part, or roughly £30,000, was unproductive, £18,000 being in respect to buildings and £12,000 for

machinery. The total capital now stands at nearly £260,000. According to the accounts, in 1898 the percentage of gross profit to capital was 5·26, and in 1899 4·34 per cent.

GENERAL STATEMENT.

	1898.	1899.	Increase.
Total capital expenditure ...	£188,518	£259,562	£71,044
Number of units sold ...	911,571	1,346,437	434,866
Total maximum load ...	500 KW.	1,080 kw.	280 KW.
Gross revenue	£21,438	£25,354	£3,916
Gross profit	£9,092	£9,521	£429
Average price per unit sold...	5·44d.	4·43d.	−1·01d.

A large reduction was made at the beginning of 1899 in the charge for electricity supplied to the public lamps. During 1898 the rate of charge was 5d. per unit. From January 1st of last year the rate was reduced to 3½d. per unit. This sum covers all charges for interest on capital, supply, repairs, trimming and carbons, &c. The rate of charge to private consumers was reduced by the elimination of the 6d. rate at and after the end of the January to March quarter. At the old rates the total units sold would have produced £5,441 more, being £4,126 in respect to public lighting, and £1,315 in respect to private lighting. The effect of the reduction is seen in the drop from 5·44d. to 4·43d. per unit for sale of energy, the difference being practically 1d.

REVENUE STATEMENT.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Sale of energy	£20,658	5·44d.	£24,835	4·43d.	−1·01d.
Meter rents	293	·08d.	382	·07d.	−·01d.
Rent received and bank interest	444	·11d.	105	·02d.	−·09d.
Sundry fees	43	·01d.	32	·00d.	−·01d.
Gross revenue ...	£21,438	5·64d.	£25,354	4·52d.	−1·12d.

The increase in output, &c., may be shown as follows:—

Year.	Total units sold.	Increase over previous year. Units sold. Number.	Percentage.	Revenue. Amount.	Percentage.
1896 ...	298,000	...	...	...	...
1897 ...	504,000	206,000	69	£4,716	62
1898 ...	911,000	408,000	81	£9,021	73
1899 ...	1,346,000	435,000	48	£4,090	19

Public lighting is an important matter at Islington:—

	Units—Private supply and revenue.		Units—Public lighting and revenue.		No. of public arc lamps.
1899 ...	686,225	£15,254	660,212	£9,628	330

The costs have improved considerably, and each item has been reduced. Coal stands at about 1d., and wages at ¾d. Works' costs have been brought down to 2½d. nearly, by about ½d., while total costs stand at a little over 2⅞d., being ⅔d. less than in 1898. We hope to see these figures still further improved during the current year.

COST OF PRODUCTION.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Coal	£4 614	1·22d.	£5,707	1 02d.	−·20d.
Oil, waste, water, and engine room stores	1,222	·32d.	1,820	·32d.	·00d.
Salaries and wages incurred in generation and distribution	2,979	·78d.	4,062	·73d.	−·05d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	1,087	·29d.	1,254	·22d.	−·07d.
Works' costs	£9,902	2·61d.	£12,843	2·29d.	−·32d.
Rent, rates, and taxes ..	665	·18d.	820	·15d.	−·03d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	1,043	·27d.	1,365	·24d.	−·03d.
General establishment charges, stationery and printing, law charges and insurance.	642	·17d.	732	·13d.	−·04d.
Other expenses	94	·02d.	73	·01d.	−·01d.
Total costs ...	£12,346	3·25d.	£15,833	2·82d.	−·43d.

The reduction in price and consequent tendency to prevent an inflation of the gross profit has led to the net profit being cut down to less than £400. The interest and sinking fund charges rose by £2,256, while the gross profit only increased by £429. The difference therefore accounts for the diminution of net profit.

PROFIT STATEMENT.

	1898.	1899.
Interest on loans and deposits overdraft ..	£4,945	£6,568
Sinking fund for repayments	1,940	2,573
Net profit carried forward	2,207	380
Gross profit	£9,092	£9,521

CITY NOTES.

British Electric Traction Company, Limited.

SIR C. RIVERS WILSON presided at the annual meeting of this company, held at Donnington House on Monday morning.

In moving the adoption of the report (which appeared in the ELECTRICAL REVIEW last week) the CHAIRMAN said that the working of the 15 months covered by the report had been of a very satisfactory character. The electric traction industry had now established a firm hold upon the country, and this company may fairly be looked upon as the leading representative of that industry. They would continue to act upon the lines of policy which had been followed during the last few years. The proceeds for the period under review, after paying all general expenses and interest on debentures amounted to £130,174. That figure included £35,451 balance brought forward, but did not include the premiums on new issues, which amounted to £160,529, which had been carried direct to reserve. The actual profit on the operations, excluding the balance brought forward, was £94,723, which compared with a net profit of £57,974 earned in the preceding 12 months. There was a surplus of £131,174 to deal with, and it was stated in the report how it was proposed to apply that sum. There remained a balance of only £5,000 to be written off goodwill account. The reserve fund, without counting the £20,000 now to be added, amounted to £189,055, but that amount was entirely derived from premiums on new issues of shares and debentures. A big business, such as the company was conducting, required some provision to be made against contingencies of all kinds, or unexpected reverses. However carefully the business was carried on, they could not help making losses. All ordinary losses should be met out of the year's income, but provision had to be made against losses of an abnormal kind. They hoped to establish a reserve out of profits, which reserve would be available for the equalisation of dividends and for any other purpose. He hoped the shareholders would not interpret his words to mean that the reserve which was built up from premiums on new capital could not be applied in that way, but a reserve created by premiums on capital should not be touched except to provide for losses of an exceptional character. They proposed in this way to have a double reserve. He thought that that policy would maintain and enhance the credit of the company. £23,051 had to be appropriated to the cumulative dividend on the preference shares. Part of this had been paid by way of interim dividend, but that was the total charge in respect of the preference for the 15 months. With reference to the ordinary dividend, the company was formed in October, 1896. For its first year no dividend was paid, for the year ended 1898, 6 per cent., and £35,451 was carried forward, and for the past 15 months they paid 8 per cent. per annum, carrying forward £43,783. They had thus met all reasonable expectations of the shareholders, and at the same time were doing nothing to weaken the financial stability of the company, which must be their first consideration. The profit and loss account showed that the position of the company was absolutely sound, and they considered that the manner in which they proposed to deal with the profits was prudent. In regard to the capital account, during the 15 months they had issued 55,000 new shares, representing £550,000 of nominal capital, and also £250,000 of debenture stock, or altogether, £800,000 of new capital. At the last general meeting the nominal capital of the company was increased from £600,000 to double that amount, namely, £1,200,000. The present subscribed share capital was £950,000, leaving £250,000 unissued in 15,000 ordinary shares and 10,000 preference shares, and there was a balance of debenture stock which could be issued, the present issued amount being £350,000. The directors propose to allot the remainder of the share capital to the shareholders, *pro rata*, forthwith. At the last meeting a strong feeling was expressed by shareholders that all new issues should be made to shareholders. The directors, while fully appreciating and sympathising with that view, and declaring it to be their intention whenever possible to have recourse to that means of raising capital, asked the shareholders not to bind them by any drastic rule and oblige them to bind themselves under all circumstances. On the present occasion they were able to satisfy the wish of the shareholders, to whom the issue would be exclusive. The board desired to allot the shares at a price which would give existing shareholders a bonus. The remaining 15,000 ordinary shares would be allotted to the present holders of 45,000 ordinary shares, in the proportion of one new share for every three old shares, the price of issue being fixed at £13. With regard to the preference shares, the board had decided to allot the remaining 10,000 shares to the present holders of the existing 50,000 preference shares, namely, in the ratio of one new preference share for every five old shares, at the price of £11. The new ordinary shares would rank for dividend with the existing shares as from April 1st last, which would improve their negotiability. The preference shares would receive 6 per cent. on the amount paid up on August 15th next, and from that date would rank equally with the old shares, although they would not be quite fully paid up by then. It would be seen that the shareholders would receive a very substantial advantage out of the new issue of shares. Shortly, the bonus represented by the issue of the new shares would be about equal to double the divided they were now recommending. Looking into the future, the chairman said it must be obvious that the magnitude of the company's operation would call for further increase of capital, and, therefore, the directors thought that the present opportunity should be taken to increase the nominal capital of the company by the creation of 80,000 new shares, half ordinary and half preference. The nominal capital would then stand at £1,000,000 in 100,000 ordinary shares, and £1,000,000 in 100,000 preference shares, and, of course, there would be a corollary power to issue a proportionate amount of debenture stock. In

regard to "contracts and undertakings," that item appeared in the balance-sheet at December, 1898, as £157,730, and now it stands at £543,246. That represented the total expenditure upon lands, buildings, permanent ways, electrical equipments, Parliamentary and other rights, negotiations, surveys, and so forth. It included the whole of the expenditure on work done by the company not yet recoverable. This had been divided under three heads in the report. The expenditure incurred on account of associated companies in which they had an interest was included in this item. The B E T. Company undertook various operations and works on the part of others. They did the work at a profit. When powers had been obtained they undertook the engineering work, reconstructing the permanent way and installing the electrical apparatus. The amount representing work in progress was £277,000. The sum of £234,019 represented works and similar undertakings which the B E.T. Company owned, leased, or controlled. On that expenditure no profit was made until the works were completed and undertaken by others or operated by themselves. This item included a large amount for stores. They had recognised the need of purchasing materials in bulk. Prices had risen enormously, but owing to the foresight of the staff they made many purchases a long way in advance at a time when prices were lower. They had saved money and avoided delays of supplies which were the general characteristic of this industry in this country. The work this company had done had given rise to a great demand for tramway materials. They had now decided to erect buildings for the convenient storage of tramway supplies, to be afterwards retailed to the various undertakings all over the country. A site had been acquired in the Midlands, which was conveniently situated for the centralisation of railway materials, and they believed that this part of the business would be a source of profit in the future. The other item was £32,077 for cost of negotiations, and legal, engineering and other services in connection with the development of new schemes in course of promotion. That might appear large, but the number of schemes was also very large, and the work was done efficiently and at the lowest cost with a view to profit in the future. The £543,246 included a portion of the general expenses. The system adopted by the directors since the beginning of the company—and it had been approved by the auditors—was to allocate or charge every month the whole of their expenses to the various undertakings and schemes in regard to which the expenses had been incurred. At the end of the year all the schemes which possessed vitality and constituted assets were included under the head of contracts and undertakings in the balance-sheet, and all the schemes which had proved unsuccessful or which represented losses were written off and charged to profit and loss account, the sum so written off in the present accounts being £15,185. In this way the difficulty—always very great—was got rid of of apportioning by way of estimates at the end of the year the items which were chargeable respectively to revenue and to capital. The amount, therefore, which stood against contracts and undertakings represented valuable assets. Coming to the investments, these stood at £950,280, and included upwards of £60,000 loans and advances to associated companies and others. That amount had been materially reduced since the closing of the accounts, and stood now at £23,000. That arrangement was of great assistance to the associated companies. Consols and national war loans could not be bettered for security, but for large interests they could not do better than invest in their own companies. It was better, therefore, to leave a large portion of the reserve in the business of the company. The last item under the head of investments consisted of shares of associated and other companies standing at £721,180, which included the nominal value of the shares held by them in the original Pioneer Company, but this was only a book entry, as it would be seen on the other side of the balance-sheet that they owed £25,000 to that company in respect of the purchase of the latter's undertaking. The Pioneer Company, however, it was expected, would shortly be wound up, and these two items on each side of the balance-sheet would then disappear. The rest of the shares held by them in shares of other companies cost close upon £700,000, but their nominal value was about £900,000. The directors thought that the principle of bringing these shares into the balance-sheet at what they cost the company was the only right one. If he had to assess the amount of depreciation in the various investments, he would, he said, be perfectly safe in stating that it would be amply covered by between £5,000 and £10,000, but this would be without taking into account the considerable appreciation of many of the investments. After explaining the superannuation scheme at some length, the chairman proceeded to refer to the position of some of the directors. When the officers were appointed, they were not allowed to take for their own use any fees received for their services. Those fees were paid into the B.E.T. Company. Their managing director, who acted as chairman or director of 13 of their companies, did so without any additional remuneration. They might wonder that Mr. Garcke was able to act as chairman or director of so many companies. The fact that he did so, and with such success, was an illustration of the very remarkable organisation of the B.E.T. It was a matter of good organisation which enabled him to distribute his time and labour in the way he did. No work done by him or by the other two gentlemen who worked with him was perfunctory or imperfectly performed. Whatever fees these gentlemen received as directors were paid into the general funds of the company. Messrs. Raworth and Drummond very largely assisted in that important work, and it was obvious that they could not be asked to do this by virtue of their position with the B.E.T. The board had arranged to pay Mr. Raworth and Mr. Drummond an additional moderate fee which had hitherto come out of the amount allowed by the directors' fees. Out of the fee fund established by the fees paid into the treasury as appertaining to the associated companies, some moderate payment was to be made to them in addition to their ordinary salaries as directors drawn from the established funds under the articles. In order to obtain uniformity of practice in the administration of the various undertakings, the board had appointed a committee with the addition of Mr. Hilton. An appendix to the report enumerated 57 undertakings, of which 53 were tramway and light railway concerns, some of which would also probably undertake the supply of electric light and power. Of these 53 undertakings, 31 were in operation and working at a profit. The company were interested in or controlled altogether about 350 miles of tramways and light railways. After referring to these schemes in certain detail, the chairman moved the adoption of the report.

This was seconded by Earl Rathmore and carried *nem con.*

The other necessary resolutions approving the superannuation fund proposal, re-electing directors, auditors, and so forth, were passed. The resolutions (respecting increasing the capital and approving certain light railway Bills), which were printed in our last issue, were also passed at an extraordinary general meeting.

The Bastian Meter Company, Limited.

The directors' report for the 12 months ending February 28th, 1900, to be presented to the shareholders at the meeting at Bartholomew Works, Kentish Town, N.W., on Thursday, June 28th, reads as follows:—

Your directors have the pleasure to submit to you the second annual statement of accounts, made up to February 28th, 1900, a period of exactly 12 months. The profit and loss account shows a profit of £388 13s. 8d., whereas the loss on the previous year amounted to £2,227 16s. 11d. Your directors consider this shows satisfactory progress. During the first six months of the year the company was worked at a somewhat heavy loss, but nearly the whole of this loss was recouped out of the profits made on the second half-year's trading, when the orders received were increased more than fourfold. The electrical installation at Holbein House has been let on lease at a satisfactory rental, and the company is thereby relieved of any further trouble or expense in connection with that department of the business. The expenditure upon experiments has been very small, as compared with the amount previously expended; and your directors anticipate that this item will continue to decrease. The prospects for the coming year appear to be most satisfactory. Markets are being opened up abroad, particularly on the Continent and in Australia. A license to work the company's patents in Germany has been arranged on satisfactory terms, and agencies have been established for Belgium, Holland, Italy, and Western Australia. Although the Board of Trade certificate for the Bastian meter is not yet in the company's possession, your directors have obtained authority to state that the meter has been officially approved by the Board of Trade, and the certificate will be prepared in due course. Mr. Bastian retires from the Board by rotation, but being eligible, offers himself for re-election. The auditors, Messrs. Percy Mason and Co., also offer themselves for re-election.

The Harrow Electric Light and Power Company, Limited.

The directors' report which was presented to the shareholders at the fourth annual general meeting on 14th inst., reads as follows:—

The steady progress made by the company from its start has been continued during the past year, as will be seen from the following table:—

Year.	No. of lamps (8 c.p.) connected in year.	Units supplied to customers in year.	Amount due from customers in year for current, meter, rent, &c.	No. of consumers connected in year.
In 1897	1,540	50,109	£1,730 8 3	48
„ 1898	2,715	79,419	2,786 0 4	68
„ 1899	2,985	113,561	3,663 5 7*	94

* Price of current for lighting purposes reduced from 8d. to 7d. from Lady Day.

The increased demand has made it necessary to order a new steam dynamo of 150 kw. (those now in use having a capacity of 60 kw. each only) and an electric pump. The dynamo is to be ready in September, and the pump has been already fixed. The boiler ordered in 1898 was fixed in the course of the year at the cost of £1,080 15s. Besides the reduction in price from 8d. to 7d. per unit for current supplied for lighting purposes since Lady Day, 1899, the company have supplied current for arc lamps and heating and cooking purposes at 4d. per unit. The works' cost for the year has been reduced to 2·4d. per unit sold. Had the station remained in Messrs. Crompton's hands on the old terms the working cost in 1899 would have amounted to an additional £321. The business of the company has been pushed by the directors, and extensions made in Butler, Byron, College, Greenhill, Headstone, Kenton, Kimberley, Lowlands, Lyon, Middle, Lower, Mount Park, Oakley, St. Kilda's, and Vaughan Roads and Roxborough and Kenton Avenues, Roxeth Hill, and along Northolt Road to the Roxeth New Sunday Schools, and the Harrow School Laundry. A considerable part of the extensions has been carried out by the company's engineer and men in a satisfactory and economical manner. The total cost of the extensions was £3,152 13s. 10d. During the year 78 houses have been wired for consumers on the rental system, against 34 in 1898. Arrangements have also been made by which a large number of houses have been wired by the company during building. This is especially advantageous as building operations are now taking place on a large scale. The wiring business increased so rapidly that it appeared to the directors that it would be convenient and profitable for the company to have their own wiring department in addition to employing Mr. Tate, who had been carrying out all the work previously. They therefore made arrangements for starting the new department at the beginning of 1900, taking the office portion of "Flambards" in High Street as a show-room and wiring and general offices. There has been a considerable demand for current in that part of the Harrow Urban District which was transferred to the Harrow district from Wealdstone in 1895, and as this area was not included in the company's provisional order which was obtained in 1894, the directors came to the conclusion in the Autumn that it would be advisable to apply for a provisional order for the district in question. As it was then too late for the company itself to apply to the Board of Trade (notice having to be given under the Electric Lighting Acts to the local authority in June), the directors asked the District Council to make the application themselves on the terms of the company paying all the expenses, and the Council transferring the order to them, if and when obtained, on the same terms as the original order was transferred, except that the repurchase clauses were to run concurrently with those in the first transfer. The Council assented, and application was made in November to the Board of Trade. The Board of Trade

have now granted the order, and the Bill to confirm it has already been passed by the House of Lords. Prepayment meters have been supplied to consumers who desire them. They have been satisfactory, but have not been largely taken up. Of the £35,000 to which the capital of the company was increased at the last annual meeting £25,000 has been issued in ordinary, and £7,500 in 4½ per cent. preference shares. Of the £25,000 in ordinary shares £22,485 were taken up and paid for by the end of the year, and the remaining £2,515 applied for and allotted. Of the £7,500 in preference shares £5,375 were taken up at the end of the year, leaving £2,125 available. It will be seen from the accounts that further capital is needed, and the directors propose that the authorised capital be increased by £15,000, and that of the whole capital so increased an amount not exceeding one third may, in the discretion of the board, be constituted preference shares, bearing a preferential dividend of 4½ per cent. The sum available for dividend after paying interest on debentures, mortgages, &c., is £1,296 14s. 8d. Out of this it is proposed to write a further £25 off leasehold property, to place £425 to depreciation of plant, to pay £92 14s. 5d., being 4½ per cent. on the preference shares issued to the end of the year, and to pay a dividend of 8½ per cent. on the ordinary shares, which will absorb £745 5s. 5d., leaving a balance of £8 14s. 5d. to carry forward. The directors received £150 as their remuneration, in accordance with the vote of the shareholders at the last annual meeting, and the shareholders are asked to settle their remuneration for 1900. Messrs. C. Colbeck and F. S. Winkley retire from the board by rotation, and being eligible offer themselves for re-election. Messrs. Jackson, Pixley & Co., the company's auditors, also offer themselves for re-election.

Electric and General Investment Company, Limited.—The report for the year ended May 31st shows a gross profit of £19,796, and after deducting all general charges and the interim dividend already paid on the ordinary shares, there remains a net balance of £14,711. The directors propose to carry £711 to the contingencies fund, and to pay a dividend of 5s. per share for the year (of which 2s. per share was paid in December), and a bonus of 4s. per share on the ordinary shares, and a dividend of £30 per share and a bonus of £40 per share on the founders' shares.

The Electric Lighting and Fittings Corporation, Limited.—At the meeting of shareholders of this company, held on 13th inst. at Liverpool, the following report was submitted and adopted:—"The result of the working during the past year is a profit of £564 1s. 8d, and the amount now standing at the credit of the profit and loss account is £59 16s. 4d. As anticipated in the last report, the business has materially increased, and better results have accrued owing to the facilities at the Duke Street works, and the convenience of the premises, 38, North John Street."

Mexico Electric Tramways Company.—At the meeting of this company, held on Wednesday, Colonel Sir C. Euan-Smith, who presided, explained certain matters which had happened since the end of last year, and discussed an agreement which the company had succeeded in making with the municipality. The prospects of the company were regarded as excellent. The report was adopted, and a 6 per cent. preference and 5 per cent. ordinary dividend declared.

Stock Exchange Notice.—The Stock Exchange Committee has appointed a special settling day as under:—Wednesday, June 27th. Callender's Cable and Construction Company, Limited—Further issue of 10,000 ordinary shares of £5 each, fully paid, Nos. 20,001 to 30,000, and has ordered same to be quoted in the Official List.

Sussman's Electric Miners' Lamp, Limited.—Our representative was refused admission to the meeting of this company on Monday last, and was informed that the proceedings were not open to the press. An abstract of the report has already appeared in the Electrical Review.

TRAFFIC RECEIPTS.

Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending June 16th, 1900, were £989 16s. 9d.; receipts for corresponding period, 1899, £698 1s. 5d.; aggregate for half-year to date, £8,718 7s. 6d.

The City and South London Railway Company.—The receipts for the week ending June 10th, 1900, were £1,501; June 11th, 1899, £888; increase, £613. June 17th, 1900, £1,480; June 18th, 1899, £899; increase, £581. Total receipts for half-year, 1900, to date, £30,734; corresponding period, 1899, £24,981; increase, £5,753. Miles open, 1900, 4½; 1899, 3½.

The Dover Corporation Tramways.—The receipts for the week ending June 17th, 1900, were £214 8s. 7d.; June 16th, 1899, £189 12s. 1d.; increase, £24 16s. 6d. Total receipts to date, 1900, £4,072 6s. 8½d.; corresponding period, 1899, £3,819 5s. 0d.; increase, £253 1s. 8½d. Miles of track open, 1900, 8; 1899, 8. Car miles run, 1900, 4,991; 1899, 4,337. Number of cars, 1900, 11; 1899, 11.

The Halifax Corporation Tramways.—The receipts for the week ending June 17th, 1900, were £813; week ending June 18th, 1899, £609; increase, £204. Total receipts to date, 1900, £7,935; ditto. 1899, £5,527; increase, £2 408. Number of cars, 1900, 29; 1899, 14. Miles of track open, 1900, 14; 1899, 6½.

The Dublin United Tramways Company.—The receipts for the week ending Friday, June 15th, 1900, were as follows:—D. U. T. Co., horse cars £61 16s. 7d.; ditto, electric cars, £3,665 5s. 10d.; D. S. D. Co., electric cars, £1,005 4s. 10d.; total, £4,732 7s. 8d.; corresponding week last year—D. U. T. Co., horse cars, £1,388 0s. 0d.; ditto, electric cars, £2,223 4s. 9d.; D. S. D. Co., electric cars, £1,189 1s. 8d.; total, £4,810 6s. 5d.; decrease, £77 19s. 9d. Aggregate to date, £99,314 5s. 5d.; aggregate to date last year, £85,653 12s. 7d.; increase to date, £13,660 12s. 10d. The mileage worked is 42 miles electrically, 2 miles by horses, as against 18 miles electrically, 26 miles by horses, for the corresponding period last year. Royal Irish Military Tournament, 1899.

The Liverpool Overhead Railway Company.—The receipts for the week ending June 17th, 1900, amounted to £1,424; corresponding week last year, £1,496; decrease, £72. Total traffics from January 1st to date, £34,214; corresponding period 1899, £33,291; increase, £923. Miles open, 6 57 chains.

The South Staffordshire Tramways Company.—The receipts for the week ending June 15th, 1900, were £640 19s. 11d.; June 16th, 1899, £640 16s. 11d. Aggregate receipts for 24 weeks, £16,901 18s. 9d.; last year, £15,169 13s. 1d.

STOCKS AND SHARES.

Wednesday Evening.

The reduction in the Bank rate from 3½ to 3 per cent., which we mentioned last week, has failed to counteract the sinister influence of Far Eastern politics on Stock Exchange markets. The action of the Bank of England directors was most probably dictated by their anxiety to secure a good reception for the London County Council and other municipal loans which appeared last week, and it cannot be taken as a real indication that money is going to be permanently cheaper. If, however, conditions should shape favourably for the continuance of a 3 per cent. Bank rate, the investment markets will undoubtedly benefit. But the aspect of foreign politics renders the future so difficult to read, that the general public have but little temptation to lead them in Capel Court's direction.

The opening of the new Central London Railway is exercising Stock Exchange minds a good deal in connection with the price of the shares. It is argued by some operators that for a year or two the line will do no better than the City and South London or the Metropolitan District, and that consequently the present quotation is distinctly too high. On the other hand, there is a large following of speculators on the bull tack, who are confidently expecting to reap the reward of the patience they have shown by holding their shares, in some cases for two or even three years, carrying them over from one account to another with clockwork regularity. Apart from the speculator's point of view, however, the Central London's working will be of immense interest to railway shareholders generally, and the introduction of the 2d.-all-the-way system may revolutionise the present tables for fares, if it should prove profitable, which, for the sake of the Central London holder, it is to be trusted that it will. Metropolitan and Metropolitan District stocks are inclined to weaken at the close prospect of what cannot fail to be keen competition, the former company being sure to feel it sharply.

We notice that some of our contemporaries are treading in our footsteps, and recommending the purchase of British Electric Traction Preference as an excellent investment. At the present price the yield to a buyer, allowing for the dividend, is 6d. less than 4¾ per cent. Naturally, the meeting on Monday was a very harmonious one. With such figures as were presented in the report, shareholders could hardly be anything but satisfied.

The electric supply market is now dealing in new Westminsters for the special settlement, and the price should improve to 6 premium. We also look for an advance in the Ordinary, which have been depressed, owing to sales by proprietors who preferred to take up their new shares and to buy more, rather than keep the old. There is also room for a rise in Charing Cross and Strand shares, since the new company will, at all events to start with, benefit the parent undertaking so far as the market price is concerned. A small premium is quoted on the new Debenture issue of the St. James's and Pall Mall Company.

Telegraph securities remain dull. Another sharp break in the American Railroad market was responsible for a slight drop in Anglo "A," in which speculation has now subsided to a very low ebb. As we have pointed out quite recently, the Preferred stock is well worth including in a list of mixed investments to raise the average yield per cent. The dividend seems quite assured for years to come. No tangible improvement has occurred in the West Indian telegraph descriptions, which languish under the reports lately issued. In our opinion, the stocks and shares are likely to go still lower, and intending buyers will be well advised to defer making their purchases for a while.

With the end of the war, it is being contended in some quarters that the Eastern Telegraph Company will lose a large and profitable source of business by the stoppage of Government messages, but if there should be a loss in this direction, surely it will be amply covered by the traffic accruing to the company as private enterprise becomes free to reassert itself in South Africa. Eastern Telegraph stock is certainly not worth selling on the war prospects

The new departure contemplated by the National Telephone Company with regard to a fresh system for "ringing up" has not been welcomed by the market, since it is thought that the alterations will cost a good deal more than the company can afford at the present time. But we would point out that the National Telephone board should have plenty of cash in hand, a new issue of Debentures and Preference capital having been made quite a short time ago. There is no alteration to report in other telephone shares.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation, June 13th.	Closing Quotation, June 20th.	Business done during week ended June 20th, 1900. Highest.	Lowest.
110,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	101	...
125,000	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	85 — 90	85 — 90	...	...
875,520	Anglo-American Telegraph	Stock	3 %	£3 9s	73/6	61 — 64	60 — 63	61½	...
3,062,240	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	114 —115	114 —115	115¼	114½
3,062,240	Do. do. Deferred...	Stock	...	18s. %	£1 7s	13 — 13½	12⅞— 13⅛	13⅜	12 15/16
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	3 %	...	2½— 2⅝	2½— 2⅝	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	...	165 —175	165 —175	...	...
1,563,078‡	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	102 —104	102 —104	103½	102⅝
16,000	Cuba Telegraph	10	7 %	8 %	7 %	6½— 7½	6½— 7½	7⅛	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	15½— 16½	15½— 16½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	...	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	101 —105%	101—105%	...	...
60,710‡	Direct United States Cable	20	3½%	3½%	3 %	11½— 12	11½— 12	11 13/16	11½
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	150 —155	150 —155	152	150
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	97 —100	97 —100	9⁷⁄₈	...
1,432,268‡	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	...	...	111 —116	111 —116	111¼	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14¼— 14¾	14¼— 15	15	14½
6,700‡	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	...	...	100 —103	100 —103	...	...
26,600‡	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	...	...	100 —103	100 —103	...	...
320,000‡	Do. 4 % Deb. Stock	Stock	4 %	...	...	112 —117	112 —117	...	...
300,000‡	Eastern and South African Telegraph, 4 % Mort. Deb., Nos. 1 to 3,000, red. 1909	100	...	...	...	100 —103	100 —103	...	...
200,000‡	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—3,000	25	...	...	...	100 –103%	100 —103%	...	...
180,227	Globe Telegraph and Trust	10	4½%	5½%	5½%	11¼— 11⅝	11¼— 11⅝	11⅜	11 7/16
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	15 — 15½	15 — 15½	15½	15⅜
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	12½%	...	32 — 34	30 — 34	...	...
86,800	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	53 — 57	53 — 57	...	...
100,000‡	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	...	...	105 —108	105 —108	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	...	...	¼— ⅜	¼— ⅜	...	...
86,492	Do. do. 5% Pref., Nos. 1 to 86,492	1	4 %	4 %	2½%	⅝— 1	⅝— 1	...	...
490,000	National Telephone, 1 to 490,000	5	6 %	6 %	5 %	4½— 5⅛	5 — 5⅛	5 1/16	5
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 15	12 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	6 %	5 — 5½	5 — 5½	5 1/16	...
2,000,000‡	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	98 —101	98 — 101	100	99¼
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	1 1/16— 1 1/16	1 1/16— 1 1/16	...	...
100,000‡	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	...	...	102 —105	102 —105	...	...
11,889	Reuter's	8	5 %	5 %	5 %	7½— 8½	7½— 8½	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	124 —129	125 —130	128	...
58,000	United River Plate Telephone	5	5 %	6 %	6 %	4½— 5	4⅝— 5⅛	5	...
16,639	Do. do. 5 % Cum. Pref. Nos. 1—16,639	5	...	...	...	4⅝— 5⅛	4⅝— 5⅛	5 1/16	...
179,947	Do. do. 5 % Debs.	Stock	..	...	...	103 —106	103 —106	...	...
200,000‡	West African Telegraph, 5 % Debs.	100	%	...	...	97 —100	97 —100	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	...
389,731	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	102 —105	102 —105	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	14½— 15	14½— 15	15	14⅜
75,000	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	105 —108	105 —108	...	...
88,321	West India and Panama Telegraph	10	¾ %	2 %	⅝ %	⅝— ⅞	⅝— ⅞	...	...
34,568	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	...	...	6½— 7½	6½— 7½	6⅝	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	...	...	6 — 7	6 — 7	...	...
80,000‡	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	...	...	104 —107	104 —107	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	4 %	6 %	6 %	7 — 8	7 — 8	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	...	...	8½— 9½	8½— 9½	8⅞	8⅝
50,000	Charing Cross and Strand Electricity Supply	5	7 %	8 %	9 %	9 — 10	9 — 10	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	...	...
84,000	*Chelsea Electricity Supply, Ord., ...	5	6 %	6 %	6 %	6½— 7½	6½ - 7½	7⅛	6⅞
150,000	Do. do. do. % Deb. Stock Red....	Stock	4½%	...	...	109 —112	107 —110	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	10 %	6 %	4 %	9 — 10	8½ - 9½	8 13/16	8⅝
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12½ - 13½	12½ - 13½	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	...	...	124 —129	124 —129	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	4 %	9 — 10	9 — 10	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	11½ - 12½	11½ - 12½	11 2/8	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	110 — 113	110 —113	...	...
26,100	Edmundsons Elec. Corp., Ord. Shares	5	5 %	7 %	...	4½— 5	4½— 5	4⅝	...
75,000	Do. do. 4½ % 1st Mort. Deb. Stock ...	100	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1 — 1½	1 — 1½	...	...
49,840	Do. do. do. 6 % Pref.	5	...	6 %	...	4 — 4½	4 — 4½	...	...
250,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	100 —102	98 —100	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	6 %	5 %	5 %	13½ - 14½	13½ - 14½	14½	14 1/16
220,000‡	Do. 4½ % First Mortgage Debenture Stock	...	4½%	...	...	113 —116	113 —116	...	...
220,000	Do. 3½ % Mort. Deb. Stock Red.	Stock	...	...	...	97 — 99	97 — 99	...	...
6,452	Notting Hill Electric Lighting	10	6 %	6 %	7 %	15½ - 16½	16 — 17	16 3/16	16 1/16
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½ - 15½	14½ - 15½	14⅝	14⅜
30,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½ - 9½	8½ - 9½	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2¼	...	...
50,000	Do. Do. 4 % Deb.	100	...	...	...	85 — 95	85 — 95	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	3¾— 4¼	3⅝— 4¼	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	12 %	12 %	13 %	13 — 14	11 — 12	11 11/16	11¼

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‡ Dividends paid in deferred share warrants, profits being used as capital
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation June 13th.	Closing Quotation June 20th.	Business done week ended June 20th, 1900. Highest.	Lowest.
		‡							
65,000	Aluminium shares, Nos. 1—65,000	1	10 %	20 %	...	2⅜— 3¼	2⅜— 3¼	3 1/16	2⅜
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	96 —101	96 —101	...	...
80,000	British Electric Traction	10	...	6 %	...	15½— 16½	16 — 17	16⅜	16⅛
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 13	12½— 13	13 1/16	12⅝
200,000	Do. do. 5 % Perpetual Debenture Stock	Stock	...	...	...	124 —127	124 —127	...	...
85,000	†British Electric Works Co., Ord. £1 shares, 50,001—135,000	...	...	...	...	⅞— 1	⅞— 1	...	...
50,000	† Do. do. 6 % Cum. Pref., 1—50,000	...	...	...	...	1 3/16— 1 5/16	1 3/16— 1 5/16	...	...
500	† Do. do. 4½ % 1st Mort. Deb.	100	...	...	...	99 —101	99 —101	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	15 %	15 %	20 %	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500	5	...	...	...	6 — 6½	6 — 6¼	5 13/16	...
90,000	Brush Elecl. Engng., Ord., 1 to 90,000	3	3 %	5 %	...	1⅝— 2	1⅝— 1⅞	1⅞	1 11/16
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 %	6 %	...	2 — 2¼	2 — 2¼	2	...
125,000	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	109 —114	109 —114	110¼	110
50,000	Do. do. 4½ % 2nd Deb. Stock Red.	Stock	...	...	...	103 —105	103 —105	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000	5	12½%	15 %	15 %	13½— 14½	13½— 14½	14⅛	...
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	...	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —116	112 —116	...	...
213,533	Central London Railway, Ord. Shares	10	...	...	...	10 — 10⅛	10 — 10⅛	10⅛	10⅛
61,033	Do. do. Pref. half-shares	5	...	...	...	4⅞— 5⅛	4⅞— 5⅛	5⅜	5
71,447	Do. do. Def. do.	5	...	...	...	5 — 5⅛	5 — 5⅛	5⅛	...
855,000	City and South London Railway	Stock	1½%	2½%	1½%	65 — 68	65 — 68	67	65½
37,500	Do. do. Ord. shares, Nos. 22,501 to 60,000	10	...	...	...	6 — 7	6 — 7	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	8	...	6 %	...	3½— 4	3½— 4	3¾	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	...	2 — 2⅛	2 — 2⅛	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	6 %	6 %	...	3½— 4½	3½— 4½	...	...
344,023	Do. do. do. 4 % Deb. Stock Red.	100	...	...	...	93 — 95	93 — 95	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	2 — 2¼	2 — 2¼	2 1/16	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000	2	7 %	7 %	...	2⅞— 3¼	3 — 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock	Stock	...	...	...	103 —106	103 —106	...	...
9,600	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600	10	7 %	7 %	...	10 — 11	10 — 11	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	12 %	14 %	15 %	13 — 14	13 — 14	...	...
30,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	...	5¼— 5⅝	5¼— 5⅝	5 5/16	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	4½ %	...	...	110 —114	110 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works	10	10 %	10 %	...	21 — 22	21 — 22	...	...
800,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —103	100 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	3½%	3⅜%	9½— 9⅝	9½— 9⅝	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13½— 13½	13 — 13½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	34 — 38	35 — 39	37½	35⅝
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909	100	...	...	...	102 —105	102 —105	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	...	8 %	12 %	11½— 12½	10½— 11½	..	...
20,000	Do. do. 5% Cm. Prf. Nos. 1 to 20,000	5	...	...	...	5½— 6	5½— 6	5 7/8	...
540,000	Waterloo and City Railway, Ord. Stock	100	...	3 %	3 %	100 —103	100 —103	...	...

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½ % Debentures of £100, 104—106.
National Electric Free Wiring, 12/6 paid. ⅜—½.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 17½—18½.
Do. do. Pref. (£10 pd.), 10—11.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6 % £5 (fully paid), 7 —7⅛. Debentures, 102—104. Dividend, 1899, on Ordinary Shares 11 %.
*T. Parker, £10 (fully paid), 17½.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (June 14th, 1900).

MARKET QUOTATIONS, Wednesday, June 20th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal)	per ton	£33	£34	£1 dec.
a ,, ,,	per ton	£30	£31	£1 dec.
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£17	£17	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90 %)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25 10	£26	10s. dec.
a Lead, Nitrate	per ton	£25	£25	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.)	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks	per lb.	3¾d.	4d.	¼d. dec.
a ,, Caustic (75/80 %)	per ton	£24	£24	..
a ,, Bisulphate	per ton	£25	£25	..
a Shellac	per cwt.	68/-	68/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6	£6	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£8	£8	..
a ,, Bichromate, casks	per lb.	3½d.	3½d.	..
METALS, &c.				
Aluminium Wire, in ton lots	per ton	£294	£294	..
b ,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£80 to £150	£80 to £150	..
c Brass (rolled metal 2' to 12') basis	per lb.	7¾d.	8¼d.	¼d. dec.
Tube (brazed)	per lb.	10d.	10¼d.	¼d. dec.
c ,, ,, (solid drawn)	per lb.	9d.	9d.	½ ..
c ,, Wire, basis	per lb.	8¼d.	8¾d.	¼d. dec.
c Copper Tubes (brazed)	per lb.	11¼d.	11¼d.	..
c ,, ,, (solid drawn)	per lb.	11¼d.	11¼d.	..
g Copper Bars (best selected)	per ton	£83	£84	£1 dec.

METALS, &c. (*continued*).		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£83	£84	£1 dec.
g ,, Rod	per ton	£83	£84	£1 dec.
e ,, (Electrolytic), Bars	per ton	£81	£81	..
e ,, ,, Sheets	per ton	£90	£90	..
e ,, ,, Rod	per ton	£84	£84	..
e ,, ,, H.C. wire	per lb.	9¼d.	9¼d.	..
f Ebonite Rod	per lb.	8/-	8/-	..
f ,, Sheet	per lb.	5/-	5/-	..
m German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha, fine	per lb.	8/- to 8/6	8/- to 8/6	..
h India-rubber, Para fine	per lb.	4/1 to 4/1½	3/11½ to 4/1	inc.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants)	per ton	69/6	69/6	1s. dec.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i ,, Wire galvanised No. 8	per ton	£18 5	£18 5	..
g Lead, English Ingot	per ton	£17 7 6 to £17 10	£17 2 6 to £17 7 6	inc.
g ,, ,, Sheet	per ton	£18 10	£18 10	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bottle	£9 10	£9 10	..
d Mica (in original cases), small	per lb.	3d. to 9d.	3d. to 9d.	..
d ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, large	per lb.	3/8 to 7/8	3/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, r'l'd str'p & sheet	per lb.	From 1/8	From 1/8	..
e Platinum	per oz.	£3 13 6	£3 12	1/6 inc.
p Silicium Bronze Wire	per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n	p. ton	From £15	to £40	..
i Steel, Magnet, in bars		£58	£58	..
g Tin, block	per ton	£140 to £141 10	£140 to £141	..
g ,, foil	per lb.	1/9	1/9	..
n ,, wire Nos. 1 to 16	per lb.	1/9	1/9	..
p White Anti-friction Metals—				
"White Ant" brand	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles	pr lb.	8½d.	8½d.	..
j ,, Best Flax, 6 lea.	per lb.	6d.	6d.	..
j ,, Hemp, 8 ply 10 lbs.	per lb.	4½d.	4½d.	..
j ,, ,, Russian, 10 lbs.	per lb.	5½d.	5½d.	..
j ,, Jute, 120 lbs. rove	per ton	£14	£14	..
k Zinc, Sheet (Vielle Montagne bnd.)	p.t.	£25 15 nett.	£25 15 nett.	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e Messrs. Frederick Smith & Co.

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f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
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j Messrs. Henry C. Fox & Co.

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k Messrs. Morris Ashby, Limited.
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o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

THE MUNICIPAL ELECTRICAL ASSOCIATION, 1900.

ABSTRACT OF PRESIDENTIAL ADDRESS

By A. B. Mountain, Borough Electrical Engineer, Huddersfield.

Wednesday, June 20th.

In presenting to you my Presidential Address, I avail myself of the opportunity of very sincerely thanking you for the great honour you have done me in electing me your president.

Many present may remember that the Board of Trade proposed in 1895 to issue new regulations for controlling the supply of electricity; the engineers of the various municipalities affected met together, and by combined efforts were enabled to persuade the Board of Trade to modify considerably the regulations which were finally issued in 1896.

The engineers who were in consultation while the Board of Trade regulations were under consideration, decided to form this Association, feeling that by combination they would be stronger and better able to bring those interested in municipal electricity supply undertakings together for the purpose of interchanging ideas and experiences, and, if necessary, take action to further or protect the interest of the undertakings in their charge. The Association at its first meeting had only 24 members who were electrical engineers being permanent officials of municipalities. But since the Association was first formed it has grown year by year in the most satisfactory manner. There are now 74 committee and 84 electrical engineer members, three associate members and 57 associates. The work accomplished by the Association in the past has, I feel certain, been very much appreciated by the local authorities interested, and although we may with a certain amount of pride look back on past achievements, yet the future work of the Association must be of still more importance to all those interested in electricity supply works owned by local authorities.

One of the first subjects discussed by the Association was the control of both gas and electricity undertakings by one committee. Now, with very few exceptions, the electricity supply is controlled by a special committee, and, judging by the progress of both departments during the last few years, it would seem conclusive that the healthy competition has been in the interest of both undertakings.

At our first convention two or three Corporations had attempted to increase the pressure of supply to consumers, and the pressure usually delivered was 100 or 110 volts; now it is quite unusual to find any three-wire system delivering a supply with a less pressure than 200 or 220 volts; in some cases the declared pressure is 250 volts. It is interesting to think of the enormous saving in copper which this increase in pressure has effected, and the saving of capital has, no doubt, in a great measure assisted the achievement of the magnificent results which have been obtained.

One of the subjects discussed by the Association in 1896 was the question of extension to outlying districts. It largely influenced those members who attended our first convention to appreciate the fact that the residential lighting was worth cultivating, and that the best way to obtain it was to extend mains as rapidly as possible to all the outlying residential sections of a town, and I consider the rapid increase in the demand for electricity is largely due to the spirit of enterprise exhibited by municipalities in encouraging a demand rather than waiting until the demand necessitated the extensions.

The consideration of wiring regulations which would be applicable to the whole of Great Britain was discussed at our first meeting, and has since occupied the time of the Association considerably. The rules which have been prepared by the Institution of Electrical Engineers, embodying the views of this Association, are of very great value. Time has not, however, removed the man who does jerry work; indeed, it seems as if those workmen who are fit for nothing else become infatuated with wiring, and are really the cause of the bad work which is being done in so many towns. One way out of the difficulty would be to organise a system of examination in connection with our Association, so that good men with a knowledge of their work could obtain a certificate. This would, I am inclined to think, check the engagement of unqualified men, and if the certificate could be withdrawn upon conclusive evidence of bad workmanship it would add to its value. I believe this system would be much appreciated by the better class of workmen, and there would no great difficulty in organising a system such as that suggested, which would weed out the incapable men. Perhaps, however, some may think it necessary to go further and weed out some of the incapable wiring contractors.

Another subject which has been very freely discussed by the Association is the supply of electrical energy for tramways and the advantages of combination over separation, the conclusion of the Association was that municipalities could combine, such combination would tend to reduce the cost of production of energy for both the lighting and traction.

Although it is, perhaps, early to draw conclusions, it is interesting to notice that the cost of production in those works where a combined supply is generated is enormously reduced, and that the committees have in some cases been enabled to materially reduce the price of energy to the consumer of electricity, and although there are three municipalities who, having had the opportunity of combination, have preferred entirely separate works, on the other hand, it is pleasing to find that 45 have accepted the views of the Association.

The formation of the Defence Fund for resisting the patent action brought by Mr. Rucker, against the London Electric Supply Corporation for the use of the alternating current system of electricity supply, is instance of the success of combination. Individual action would almost certainly have resulted in failure.

When we held our first convention there were very few engineers responsible for works, having 50,000 lamps connected to the mains, and the output of very few generators exceeded 300 kw. Owing, however, to the constantly increasing number of lamps connected year after year, it has become necessary to adopt larger units of plant, and now generators having an output of 1,000 kw. are quite usual; in fact, in many towns it has been found best to take out generators of small size and replace them with plants of very much greater capacity. This has entailed a large waste of capital, and I am inclined to think that the Association might well devote its time to the consideration of the size of plant which should be adopted for new works and extension of existing ones. I would suggest, as a moderate figure, 15 8-c p. lamps per head of the population of the area supplied; this would mean that, a town having a population of 100,000 would ultimately have approximately 1,500,000 8-c p. lamps connected to its electricity works. If we disregard for the moment the energy which will be required for driving motors, tramcars, and for many other purposes, which we should largely depend upon to find employment for our machinery during the daytime, and which would not materially increase our maximum load, we find that to supply energy to these lights, assuming one-third to be in use at the same time, we shall require, including spare plant, not less than 20 1,000-kw. generators. This would be an unnecessarily large number of generators, and undoubtedly much more economical results would be obtained by employing 10 generators having an output of 2,000 kw. each. One can only earnestly hope that when the demand for larger units arises our manufacturers of electrical plant will be in the position to supply thoroughly reliable machinery.

When we consider the probable growth of our works, one is forced to think seriously of the various systems in operation, and endeavour to ascertain the probable alteration or extension which will be necessary to meet the demand for energy in the future. Simplicity is, I think, the important point we should keep in view, it means reduced capital expenditure, reduced works' costs, and reliability of supply.

I think the future demand in any town having a population exceeding 75,000 will necessitate the erection of generating works outside the central or densely populated portion of the town, and that such works will, if the town has a continuous current supply, generate alternating current, either single, two or three-phase, which will be converted to continuous current in suitably situated sub-stations. If, however, the town has a single-phase alternating current system, I think it will have a distinct advantage over its neighbours having continuous current, in the fact that it will have a less complicated system, the capital expenditure upon which should be less, the cost of distribution due to the saving of labour should be lower, and the reliability of the system greater, unless accumulators are employed upon a large scale.

The facts and figures at present obtainable relative to two and three-phase alternating current systems are not, in my opinion, sufficiently proved to be of much value, and we should watch with the greatest interest the results of some of the systems now being installed. In my opinion the complications completely outweigh any advantage which two or three-phase systems may have over single-phase, and we must not let our engineering enthusiasm make us forget that we have to put down works for distributing electrical energy suitable for all purposes, at the lowest possible cost to the consumer.

During the last and present year much has been heard upon the subject of municipal trading, and the welfare of our electricity supply undertakings are largely involved. It would seem, however, that the sins of local authorities are those of omission. When one considers that provisional orders for electric lighting have been granted to above 300 local authorities, and that only about half are beyond the period of consideration, it must be granted that enterprise is being seriously retarded, and that the idea of obtaining an order and then waiting, Micawber-like, for something to turn up, is neither in the interest of the would-be consumers nor the industry, and it can scarcely be surprising to find Parliament considering the granting of powers to companies to supply over large areas, and also contemplating competition.

There are, however, two strong factors impeding electrical enterprise in the areas of small local authorities, both of which are having the attention of the Council of this Association. The first is, that no period being allowed for this construction of works, necessitates an immediate payment of interest on capital and sinking fund contributions; the second point is, that the period of 25 years allowed for the repayment of capital is unnecessarily short, and increases the annual proportion of the sinking fund. The consequence is that some local authorities anticipating loss by the department during the first year or two are anxious to avoid the risk of adding a burden to the rates.

I am, of course, aware that this is an excuse and not a solid reason for delaying the commencement of the work for years, and one can scarcely understand why the smaller local authorities who have obtained powers at considerable expense should not have proceeded with the work. Their want of enterprise has, in my opinion, brought into existence the larger companies who propose supplying electricity over extended areas.

A combined effort to alter the present regulations of the Local Government Board and obtain, if possible, a longer period for the repayment of loans, and also a period for construction of works can only be productive of good results, and will certainly enable many councils who are now hesitating to at once put down works and develop the supply of electrical energy for all purposes; it would also have another beneficial result in the fact that it would remove the temptation to reduce the initial capital expenditure by putting in very small plant unsuitable for the works in a few years time, but by the employment of which it may be possible to avoid a loss at the commencement.

While one is forced to the conclusion that the want of energy of

many of the smaller local authorities is likely to produce unfortunate results, it is a pleasure to review the general progress made by electricity supply undertaking, and the following figures representing the capital expended upon municipal and companies' works in the United Kingdom are most interesting:—

	1895.	1896.	1897.	1898.
Municipal ...	£1,772,323	3,392,229	4,662,909	6 979 150
Companies ...	£4,335,357	5,370,134	6,338,744	7 996,591

I am sure our consumers will be interested to hear that the average cost of producing the unit of electrical energy exclusive of capital charges is being reduced year by year, and in municipal works was during 1898, 2·12 pence per unit as against 2·7 pence per unit in companies' works, and that the average price obtained by municipalities during the same year was 4·35 pence per unit as against 5·51 pence per unit obtained by companies. These results must be considered highly satisfactory, and it is interesting to notice the causes of the reduction in the average works' costs. The chief reason for the reduction of costs is due to the reduction in the selling price. This has induced consumers to use more energy per lamps fixed. The second important factor is the more general use of electric motors which has helped very largely to increase the quantity of energy sold, and has found employment for a portion of our plant during the daytime. The supply of electricity for tramway purposes has also materially assisted the load factor and has consequently reduced the average cost of production, and as the demand for energy for motive power and tramway purposes is developed so will the cost of production be reduced.

Another opportunity of improving the load factor seems fairly near realisation, that is, the charging of accumulators for motor cars. Tradesmen require something reliable for conveying their commodities to various points usually within a few miles of their premises, and do not require to cover more than about 20 miles per day, for these purposes the electric motor car is most suitable, and the fact that its propelling machinery has no reciprocating parts should add to its reliability and reduce repairs, and if municipalities will arrange charging stations in convenient positions such cars should be speedily adopted, and if the charging is done during the night and early morning the energy used could be supplied at an exceedingly low price, and would still further reduce the average cost of production.

In Edinburgh, and in other places, motor cars are running in competition with tramways, and one is bound to consider what competition will mean. Motor cars running upon the ordinary road escape the heavy expenditure required for the permanent way of an electric or steam system of tramways, and consequently in a district having a scattered population unable to support a frequent service of cars, would have an immense advantage, in the fact that the capital charges would be very much reduced. This is, in my opinion, an extremely important point; as the financial charges upon a tramway undertaking frequently represent from 25 to 40 per cent. of the total expenses, and it is not at all unusual to find this important item neglected when the cost per car mile is being discussed.

The last subject I will mention is the municipalisation of the telephone system. The Association and the Council have devoted considerable time to the consideration of this subject, and now that Parliament has granted powers to local authorities to municipalise the local system, there should be an immediate effort made to make the telephone more popular; this can, I think, only be done successfully by the local authorities who cannot help being keenly interested in anything which aids or adds to the convenience of its residents. They would undoubtedly be able to give a more efficient and cheaper service than that at present in existence.

It is sincerely to be hoped that corporations will assist the Post Office to develop the service, and will not be either dismayed or delayed by the difficulties which may appear and which will vanish as soon as a few corporations have their systems in operation.

In conclusion, I regret that owing to the amount of work before the Association it is impossible for me to touch upon many very interesting subjects which I should otherwise, had time allowed, have thought it desirable to bring before your notice.

THE LIGHTING OF SMALL TOWNS.

By G. M. Harris, electrical engineer, Bray (Ireland).

(*Wednesday, June 20th, Abstract.*)

The lighting of small towns is a problem requiring very careful consideration, not by reason of any engineering difficulties, but by reason of the difficulty of making such an undertaking pay.

Small towns mean small consumers and usually a scattered area.

The distributing charges will be heavy, so that if there is to be any hope of success the generating charges must be light, which means that the site for a generating station must have very special natural advantages, such as good water-power or facilities for cheap fuel, or a combination of the two.

Where there are no such advantages there appears to be no alternative but to wait for the great power companies to pick up such small areas as may be within their reach or upon the direct line of route of their mains to larger ones.

Assuming that the conditions are favourable for generating or obtaining a supply at a low cost—at the commencement the public lighting should be provided for and taken over, and provision only made for private consumers where such are certain to come on in a reasonable time.

The policy of laying the mains for private use well in advance of the demand, though justified in wealthy areas, would not be so in small towns where the conditions are different.

The prospect of profit in supplying small and scattered consumers being very small, there is no room for speculation, and it is of the utmost importance that the capital expenditure be kept as low as possible, and that no capital should be unproductive.

It therefore follows that the system of distribution should possess the maximum of flexibility at the minimum of cost.

Now that distribution up to 200 volts has been successfully established, there are, of course, many towns where direct current would be feasible, and no doubt preferable, but in the majority of cases high pressure alternating current, with transformers in street pits, and occasionally in houses, would be better; where the area comprises a number of private houses and mansions, standing in their own grounds, and of necessity widely scattered, but nevertheless desirable to reach, the alternating system is the only one commercially possible. This question, however, will, of course, be governed by the circumstances in any particular district, but the question of the actual cost of mains will always remain a serious item telling against economical distribution on a small scale.

It is therefore the object of this paper to deal with the matter of cheap mains and main laying, that being, I consider, the most important point—the one which lies nearest towards a solution of the problem under consideration.

I therefore propose to bring to the notice of this association two cheap and effective methods of main-laying, of which I have had experience at Bray. First, as to the mains in operation at Bray—there have been over 6 miles of high, and 27 miles of low tension laid direct in the ground since 1892, and during that time we have never had a fault on the main line of cables themselves, except where mechanical injury had caused it, and this has very seldom happened. Any trouble we have had has been due to defects in the filling material of the jointing boxes, now overcome, so that this system of laying may claim to have been well tried. In fact, I think the Bray mains are the oldest paper-insulated cables in the kingdom, other than those from Deptford.

The cables are concentric lead-covered and unarmoured—they are taped, but this is, in my opinion, a disadvantage.

In laying, the bottom of the trench was covered with about 3 inches of puddle clay, well wrought, the cables laid in and covered with another 3 inches of puddle clay, evenly put on, and a 7-inch by 1 inch board placed on top, the trench being then filled.

Latterly, the timber used for mechanical protection has been larch—being simply the small larch trees, 7 inches thick in the butt, sawn in half—this timber stands well in the ground, requiring no special treatment to preserve it, is cheaper than deal boards, and more effective, being thicker. The effect of the puddle clay, impervious to moisture, is to protect the lead covering from any contact with acids or salts in the soil which would attack it, and it has proved so effective, that when the cable is now, after eight years, exposed, the lead is absolutely unattacked.

The braiding of the cables has rotted, proving to have been an unnecessary expense. It might prove a source of danger if it allowed a passage of water charged with matter which would attack lead, the life of a lead-covered cable being practically the life of the lead.

As to the jointing, no clips are used, the inners are married and soldered in the usual way, the outer wires are drawn to one side and soldered together, forming a loop, all soldering being done well clear of the cable insulation.

The joint is contained in a cast-iron joint box, divided longitudinally on the line of two bottle necks, for entrance and exit of cable, and having on the top side a large hole for filling (not less than 1 inch), and a smaller hole as air vent, closed by screwed plugs. The cables are served with spun-yarn up to the diameter of the bottle necks and no other packing of the glands is found necessary. The joints having been made and the box screwed up, molten pitch is poured in: the outer side of the bottle necks, beyond the spunyarn serving, is also filled in with pitch, hollows being formed in the clay for the purpose, and here fine clay mixed with the pitch forms a cement which effectually seals up the bottle necks and protects the cables from injury where they enter and leave the box. Such a joint is cheaply made and fulfils every requirement.

It demands only care and requires absolutely no special skill, a very important matter in a small town. This, and the fact that it is both electrically and mechanically sound, gives a joint, so made, advantages which no form of joint made with clips, which the writer has seen, can claim.

Where any transformer pits lie on the route all cables are brought into the pits and are joined there, inners and outers, with loops of rubber-covered single cables; disconnection of any length of cable for tracing a fault is done by snipping these loops and this works well under our conditions.

Of course in a large scheme where the expense was no object disconnecting boxes would be preferable, but when used they should certainly be placed in pillars above ground, and so above the reach of flooding, and not in water-tight boxes under ground.

As far as the writer is aware, the insulation resistance of mains in operation is not usually easily obtainable, but he has reason to believe that it is more than ordinarily low.

This, however, in no way reflects on the cables; it is partly due to the fact that originally oil was used in the joint boxes, but was soon abandoned, not, however, before the cable ends had suffered, due to water mixing with the oil; the repairing of these ends accounts for the large number of joints. The main cause of the low insulation is due to the large number of joint boxes which still contain a mixture of tar and pitch (the tar having been added as a precaution against cracking of the pitch). This mixture is inferior in every way to the pitch alone which is now always used.

The fact that the resistance from the inner to the outer is, in the majority of cases, greater than that to the earth is no doubt accounted for at the joints, where the resistance of the pitch has been weakened in the manner indicated, and the surface of the outer is small in comparison to the surrounding box. Their condition, however, causes

no anxiety at Bray, as the tests are practically identical with those taken in 1893; the cables have been perfectly steady all along, and have lived to see much of the more elaborate and costly draw-in system placed on the scrap heap.

The cost of laying the cable described was under 1s. per yard of trench, made up as follows:—

Opening and filling trench 20 inches deep, including mixing of puddle clay—from 3d. to 6d. per yard.

Puddle clay at 2s. 6d. per ton, sufficient for three cables—3d. per yard.

7 inches × 1 inch board, for mechanical protection—2d. per yard.

The average cost of a joint being under 10s., as follows:—

	s.	d.
Joint box, complete	4	6
Pitch, solder, fire, &c., say	2	6
Labour	2	6
	9	6

Sufficient has been said, perhaps, to show that such a system of laying and jointing mains is cheap and reliable, in any case in which no danger from electrolytic action is feared—as where, for instance, a tram line passed through a town—in such a case the lead would need protection, and recourse to some solid system seems inevitable; but a small town cannot afford the luxury of lead-covered cables laid in this way, and the lead seems to me quite unnecessary, serving no purposes which would not be equally served by any cheap covering which would protect the insulation from damp up to the time of being laid, after which it requires no such protection.

If the cables are concentric the outer insulation can be reduced to that thickness which, with the filling, suffices for the voltage carried; if the cables are not concentric then the covering of each may be reduced to that thickness which, with the filling, is good enough.

The question is, how much the insulation, other than that of the filling compound, may be reduced?

My impression is, that driven by consideration of cost, we shall see this extra insulation year by year reduced in amount till, for low voltage, we come to the bare conductor laid on insulators in the solid filling, and for higher voltage, conductors laid on the same system with very slight extra insulation, relying mainly upon the filling compound.

The inevitable result of this will be that we shall, for the conductors, use iron or other metal, or alloy, cheaper than copper, since the prohibitive cost of the increased insulation, due to bigger cross-section for the same conductivity for such metals, will not have to be faced. At Bray we tested, some years ago, 80 yards of bare copper mains laid on the solid system, and although roughly laid and badly insulated, the filling compound being a mixture of bitumen, tar, and sawdust, this, nevertheless, stood 1,000 volts for 12 months, and 100 volts for two years afterwards, and was then only taken up on account of building extensions.

From that experiment and subsequent experience, I believe it is perfectly possible, even now, for voltage, say, up to 500, covering all low tension distribution for light and traction, to use wires covered with, say, a few layers of paper and a light braiding varnished, and the whole laid in troughing filled in with plain pitch at 10s. per ton, which, for all sizes of copper above, say, 0·25 inch sectional area, would be cheaper than any cable in the market.

Whatever be the nature of the solid system, the compound for filling both joints and troughing should be ordinary pitch, which has the advantage that it can with ease be chipped out, and is cheap.

In most small towns, for the public lighting of outlying country roads, overhead bare wiring might be employed, for doubtless the sanction of the Board of Trade for their use, at all events for the first few years, might be obtained. On the whole, however, the regulation preventing the use of overhead wires does not press very hard upon small towns, where usually labour is cheap and the roads easily opened.

Returning to the general question, it may safely be said that where gas has been well established, the outlook for a private consumption of electricity will be in inverse proportion to the price charged for gas, for, where a high price prevails, the inhabitants will be found educated to the closest economy in its use, and it is surprising how far this can be carried.

ELECTRICITY SUPPLY FOR SMALL TOWNS.

By C. S. Vesey Brown, city electrical engineer, Lincoln.

(Wednesday, June 20th, Abstract)

For the purposes of this paper, the author has chosen those towns and districts with a population not exceeding 40,000. At the end of 1899, there were in operation in towns under this size: 56 works (28 owned by local authorities and 28 by limited companies); there were also 161 local authorities and 23 limited companies who had acquired statutory powers, of which number 50 local authorities and 16 companies were reported to have completed arrangements for equipping works, thus leaving 111 local authorities and 7 companies who had not made up their minds what to do.

Of these 111 local authorities, the following obtained their provisional orders on the dates given, viz:—One in 1890; two in 1891; four in 1892; two in 1893; and two in 1894, and of the remainder, the larger proportion were granted in 1897, 1898 and 1899.

There are also a large number of applications during the present Session, of which it is difficult to give an exact account until the Orders are granted.

The analysis of the works in operation, as regards system of distribution, is as follows:—

Local authorities.		Limited companies.	
High tension alternating.	Low tension continuous current.	High tension alternating.	Low tension continuous current
11	17	12	16

and the capital expenditure and results from those in operation for more than one year is as follows:—

	Local authorities. 14 towns.		Limited companies. 9 towns.
Capital invested ...	£406,175	...	£332,490
Average profit after payment of working expenses	4½ %	...	4½ % (average dividend)
Kilowatts installed ...	5,240	...	3,065
Average price per B.T.U. obtained ...	5·1d.	...	6·4d.

It will be seen that to a certain extent the local authorities have been obliged to subsidise their works with contributions by the general body of ratepayers, for in order to pay interest and sinking fund on the capital invested at 3 per cent., and repayable in 25 years, a return of at least 5¾ per cent. is needed.

Having obtained the necessary powers, the local authority's attention is at once directed to a number of questions, of which the following are the more important:—

A choice of system.

A selection of a site.

The question of an expert to advise on what is to be done, and how to do it.

The capacity of the generating plant.

The extent of the area of supply to start with.

Whether or not street lighting should be undertaken.

The price of supply, and on what terms there should be a rebate, according to the consumption of electricity.

Are "free wiring" contracts to be entered into, &c., &c.

If the expert's advice can be depended upon, the local authority can leave all technical details alone, and exercise in a greater degree those commercial and managerial qualifications which it is presumed have placed them where they are.

The choice of an engineer to advise and superintend the scheme is a knotty point to solve in some places.

At times the surveyor is asked to carry out the works. Other places depend on a scheme propounded by manufacturers, and, again, some authorities appoint an engineer, after considerable expense in advertising, at a wage of a first-class foreman, who is supposed to be competent to advise on all the intricate questions in the maintenance and construction of the undertaking, which, though small in size and area, yet has principles involved which require the same consideration as if the undertaking was to supply a greater district; and not only is he called upon to carry out this undertaking, but to draw plans and specifications, and in contracts provide himself as sole arbiter in cases of dispute with manufacturers, who may have in their employ engineers and experts of world-wide fame.

The author's suggestion to small local authorities is that they should employ a competent expert to advise and initiate a policy and system, and for the first stage of the undertaking pay him the usual fees; that then they should engage a resident manager, whose duties would be to manage both commercially and technically the whole undertaking, and that as extensions are required, the consulting expert should be called in to advise, he being paid an annual retainer to cover the advice given.

In this manner, the local authority would obtain the maximum of expert advice with the minimum of expense.

The site for an electricity works should be, if possible, near to a stream of water and adjacent to a coal depôt. If preference is to be given to either situation, that where easy arrangements can be made for condensing the exhaust steam is preferable.

In the author's opinion it would be a difficult matter to find a better system than the three-wire continuous current, supplying consumers at a pressure of 200—250 volts, the choice of pressure being determined by the probable extension of the feeder cables.

The generating plant should be of a simple and yet efficient character; nothing should be installed which has not stood the test of time and experience. Lancashire boilers, or where it is possible that foggy weather may be experienced, water-tube boilers are equally suitable. 125 lbs. to 130 lbs. steam pressure seems to be the most suitable standard to adopt.

The addition of an "economiser," or feed-water heater, is distinctly an advantage and should not be omitted, especially where the character of the feed-water necessitates some depositing apparatus to soften it.

The steam and feed pipe arrangements should be of the best character. There should be no possibility of joints failing or valves leaking, and in the whole of the system of electricity supply there is no policy more penny-wise or pound-foolish than that of the substitution of inferior material or curtailment of expenses in this part of the generating plant.

The engines and dynamos should be direct coupled to each other, and as far as possible should be arranged in standard sizes. By "standard" sizes is meant the standard size of any manufacturer, as near to the expert's "standard" as possible; if the expert's "standard" is insisted on, additional expense is incurred, which in the author's opinion is not warranted.

At the first stage of the undertaking, it is probable that two or three sets of from 50—100 KW. each would be installed, and that as extensions are required 150—250 KW. machines would be added, the sizes depending on the probable demand to be made for power and traction, as well as for lighting. Compound two or three-crank engines appear to be the most useful type.

The dynamos, for the first stage, should be so arranged that they

will balance the three-wire system, if necessary, without the assistance of a storage battery.

A storage battery should be provided of sufficient capacity to take all the lighting that may be required between midnight and some time in the afternoon of the next day, for, say, two years, after which time it acts only as a "safety valve," to the supply pressure.

The switchboard should be so arranged as to be easily extended, and at the same time confined to as small a limit as is consistent with safety and ease of controlling the supply.

Recording instruments for various purposes should be used. There is nothing more annoying than to be assailed occasionally with the statement that the supply is or was unsteady at some specified time, and there should be recording voltmeters to refute or confirm such statements.

Each dynamo should be provided with a recording instrument to enable its output to be calculated.

In the minor details of the works, the author is inclined to use motors for driving the various pumps, economiser scrapers and cranes that may be required, but would make an exception in the case of providing a reserve steam-feed pump.

With regard to the distributing system, concentric and triple concentric cables are most suitable. These should be laid on what is known as the "solid" system, which serves the double advantage of forming a mechanical protection against picks and water, and also against electrolytic effects, which may be deleterious to armoured cables buried direct in the ground, where tramways are in operation.

The author prefers to adopt one standard size of cable (say, ·075 square inch to ·125 square inch sectional area) throughout the distributing network, and to throw out feeders of different sectional areas to different parts of the network as the demand increases, and by a judicious selection of the size of feeders, it should be possible at some future date, if the district which is being supplied increases in value or importance, to use the feeder cables already laid as distributors, and relay larger feeder cables, for just as the gas and water companies commenced operations with small pipes, &c., so does the electricity undertaking commence operations with small plant and cables.

The meters used in consumers' premises should be well tested before being put on the circuit.

With regard to the price of supply, the author is inclined to the adoption of a price which will require little variation in the future. If a high price is fixed to start with, it is certain to have the effect of restricting the output, even though a profit may be made, and the intention of the legislature in granting the local authority powers (which amount to an absolute monopoly), is undoubtedly not that electricity should be for the rich, but for those who desire to avail themselves of it; and in connection with these remarks the author would add that a broad policy of extending the network cables over a considerable area of the district each successive year will have the effect in the long run of establishing a good connection amongst all classes of inhabitants.

In concluding this paper the author would refer to the supply of electricity in those towns where the gas undertaking is carried on by the local authority, and would suggest the following possible solutions of the difficulty which may occur in these cases:—

1. If the town is within the area of supply of one of the large power distributing companies who are, or will shortly be, operating, then a cheap and efficient way would be to lay down a network of distributing mains, and allow the company to supply "in bulk" what electricity is required, the local authority retaining the distribution of the energy and the collection of the accounts in their own hands.

2. To lay down a network of distributing mains, and instal a gas engine plant to the extent of probably 15 KW., as a pioneer undertaking, and if the demand requires, then to put up a steam generating plant.

The author has felt some diffidence in going beyond the bare outline of the suggested arrangement for dealing with this problem of supplying these small towns,* and hopes that the discussion will elicit information which will be useful to guide the powers that be into the right groove towards the establishment of efficient and successful electricity works all over the United Kingdom.

CURRENT SPECIFICATIONS.

XVIII.—DURBAN ELECTRIC TRAMWAYS.

SUMMARY.

Scope of Tender.—The supply and erection in complete working order at Durban of an electric tramway, approximately 12 miles in all, on the overhead system.

Division of Contract.—The specification is divided into three sections, A, B and C.

"Section A" includes all necessary poles and overhead equipment for, approximately, 12 miles of route, but excludes feeder cables.

"Section B" asks for 22 electric tramcars, double deck, capable of seating 50 passengers, 20 inside and 30 out, complete with trucks and full electrical equipment.

"Section C" demands plant for the complete equipment of the necessary power house.

Sections A and B will be given to the same contractor, and, if possible, Section C also.

System of Overhead Work.—The overhead work is divided up as follows:—4·337 miles centre poles, double bracket; 3·983 miles centre poles, single bracket; 3·264 miles span wire; 0·262 mile side poles, special brackets.

Types of Poles.—To be of four sizes, each made up of three sections of lap-welded steel tubes. Sizes, lengths, and weights given in specification.

Form of Trolley.—Dickinson swivelling trolley.

Type of Car Truck.—Brill 21 E, or one designed on same lines.

Capacity of Motor.—To develop 35 B.H.P. continuously for one hour, with temperature rise not exceeding 75° C. (135 F.) above surrounding air, and give a tractive effort of 1,000 lbs. at 10 miles per hour, with 30-inch diameter wheels.

Type of Controller.—To be such that it can be used in conjunction with an electro-magnetic brake of the disc type.

Alternative Offer for Car Bodies.—An alternative offer is to be given for car bodies delivered in "knock-down" form for convenience in transit.

Type of Generators.—To be of multipolar type, direct coupled to engine.

Number of Generators.—Three to be supplied, each capable of developing 250 KW. at any pressure between 525 and 550 volts at 135 revolutions per minute.

Permissible Temperature Rise.—60° F. after full load run of 12 hours.

Type of Engine.—Horizontal tandem compound condensing type, fitted with Corliss or other approved valves.

Output of Engines.—Each to be capable of driving continuously on full load at 135 revolutions per minute one of above mentioned 250 KW. dynamos, when supplied with steam at 150 lbs. per square inch pressure, and exhausting into condenser with 25 inches vacuum.

Required Overload.—Twenty-five per cent. on normal full load continuously at reduced efficiency.

Type of Boilers.—Water-tube, dry back marine, or other well-known type.

Number and Size of Boilers.—Three to be supplied, each to be capable of evaporating 7,000 lbs. of water per hour, when burning Natal coal, which may be assumed to have 40 per cent. less calorific value than Welsh coal.

Condensers.—Two to be supplied of the "Jet" type, each capable of dealing with 14,000 lbs. of water per hour. To have condensing chamber directly attached to suction chamber of air pump.

Boiler Feed Pumps.—Two to be provided, to be direct acting of either single or duplex type, each to be capable of delivering 20,000 lbs. of water per hour against a pressure of 160 lbs. square inch.

Fuel Economiser.—One to be provided capable of dealing with 14,000 lbs. of feed water per hour.

Feed Water Heater.—To be capable of heating 20,000 lbs. of water per hour to the maximum temperature with the available quantity of exhaust steam.

Water Cooling Tower.—One to be supplied complete with all accessories, of the Barnard-Wheeler type, capable of dealing with 20,000 lbs. of steam per hour.

Switchboard.—To be of latest design for traction work, arranged for three dynamos and seven feeders, with suitable provision for span and measuring panels.

Pipes.—To suit general arrangement of plant shown on plan issued with specification.

Date of Completion.—For each section to be named in tender.

Penalty for Late Completion.—£10 per day.

What Tendered Price Includes.—Supply of plant f.o.b. British port, shipping freight to Durban (Natal), insurance, landing charges, Customs dues (when necessary), delivery on site of works, erection and maintenance for period of three months from date of completion.

Terms of Payment.—80 per cent. on delivery of goods f.o.b. British port; 10 per cent. during erection on engineer's monthly certificates; 10 per cent. at end of three months' period of maintenance.

Stipulations as to Removal of Workmen.—Purchaser's engineer reserves right to demand dismissal of any workmen employed by contractor if, in his opinion, they are unsuitable.

Contractor's Representative.—Contractor to maintain in Durban, during whole period of erection and maintenance, a fully competent engineer.

Stipulations as to Wages Paid to Workmen.—None.

Arbitration Clause.—None—see notes below.

Date for Receipt of Tenders.—In London, July 20th, 1900; in Durban, August 13th, 1900.

This tender is an earnest of what may be expected when affairs in South Africa have once more assumed their normal aspect, and there is little doubt but that the competition for the present contract will be very keen on this account.

The specification has been prepared jointly by the borough engineer, Mr. J. Fletcher, A.M.I.C.E., and Mr. J. Roberts, A.I.E.E., and the work has been done in a very creditable manner. Prices are to be given in very great detail, and in view of the fact that freight, delivery, and customs and erection charges are to be allocated to every item, a very large amount of labour is involved in the preparation of the tender.

The contract includes the whole of the work necessary for the equipment of the lines, with the exception of the feeder

* On account of the many and varied conditions which obtain, say, for example, in towns in Devonshire, Staffordshire, Durham County, or in the North of Scotland.

cables, buildings, foundations for all plant and permanent way construction. A 5-ton hand travelling crane will also be erected by the Corporation, of which the contractor may have free use at his own risk.

The plant required is roughly scheduled in the above summary; as regards tests, the specification is a little ambiguous. A "representative engineer" will be appointed by the Corporation to act on their behalf in England, and before obtaining payments the "inspecting engineer's" certificate as mentioned below must be obtained. No special steam consumption tests are, however, specified to take place before delivery, and tenderers will do well to stipulate that the tests to determine whether at the percentage loads specified the steam consumption per I.H.P.-hour fulfils the guarantee sent in with the tender shall be made at the expense of the Corporation during the three months' period of maintenance.

Both the steam consumption per I.H.P.-hour and the commercial efficiency of the dynamo must be guaranteed, but no stipulations are made as to the mechanical efficiency of the engine; this prevents any covering steam consumption figure per kilowatt-hour being demanded, and will to a large extent nullify the value of any series of expensive tests.

In sending in a tender a great number of risks have to be provided for. Clause 4 of the general conditions which deals with this question states that—

The tender, *which is to be made in detail* as set forth in the bill of quantities, *must include the cost of material, shipping, freight, insurance, customs, and landing charges, delivery on the site of works, erection, and every expense necessary for completing and upholding the whole of the works herein specified respectively for three calendar months after the completion of the works; except unskilled labour* and other work distinctly mentioned in the following specifications, and for replacing any portions which during the period may fail or show signs of undue wear, subject to all the contingencies, conditions, and stipulations herein contained or referred to.

The native labour which the Corporation will provide will be of the most unskilled character.

In view of the long distance of the site from England, it is important that the terms of payment should be clearly stated. These are as follows, which is a copy of Clause 22 in the general conditions:—

The contractor shall be entitled to receive payment to the extent of 80 per cent. on all materials when such materials shall have been delivered free on board at the nearest port, on presentation to the corporation agents of all shipping documents and inspecting engineer's certificates that the materials have satisfactorily complied with his tests. These payments will be made in London. A further payment of 10 per cent. on materials will be made on engineer's monthly certificates as erection proceeds, and the remaining 10 per cent. on materials will be held over till the end of the three months' period of maintenance. Payments for construction will be made in full on monthly certificates in Durban. All payments on certificates in Durban will be made by the corporation agents in London not later than one month after the date of the granting of such certificates.

The following clause *re* penalties for late completion is important; in our opinion the wording should be modified to make definite allowance for undue delays at sea, whether arising from accidents, stress of weather or detention of the ship in quarantine.

Should the contractor make default in the completion of his contract by the date specified in his tender, he shall pay to the corporation the sum of 10 pounds sterling (£10) as liquidated damages for each and every day during which the contract shall remain uncompleted beyond the specified time, and the corporation shall have power to deduct such sum or sums from any monies which are or may become due to the contractor on this contract or on extras thereto, or may recover the same by process of law, and time shall be the essence of the contract. Provided always that if the works be delayed by reason of combination of workmen or lock-outs affecting these works or any of the trades concerned in the supply of materials to these works, or other causes in the opinion of the engineers beyond the contractor's control then the contractor shall complete the work within such extended time as the engineers shall consider to be reasonable, and shall from time to time in writing appoint, in substitution of the time specified in the tender, and in case of default by the contractor in completing by such time appointed, the contractor hereby agrees to allow the corporation such rebate or reduction as hereinbefore is set forth.

The following clause *re* the employment of competent foremen is fair and just, and in the powers reserved to the engineers to object to unsatisfactory workmen there is nothing unfair in itself; its strict observance might, however, be the direct means of a long delay in the completion of the work, and the incurring of serious penalties by the contractor, unless the engineers made due allowance for any delays caused by sending new men out from this country. The clause reads:—

Only competent foremen who have carried out similar work on other tramways shall be employed by the contractor's representative to superintend the execution of work.

***The engineers shall have full power to require the dismissal of any foreman or workman in the employ of the contractor* who may, in the opinion of the engineers, be incompetent, negligent, or guilty of unsteadiness or incivility, and the contractor shall (after notice) replace him or them with other men to the satisfaction of the engineers, and within a reasonable time; or in default of so doing, the engineer shall have full power to appoint a competent person or persons to carry out their instructions, and deduct the cost of wages from any monies due, or to become due, to the contractor.**

The clause relating to variations in the value of the contract is satisfactory; the Corporation agree to "accept the full quantity of all material specified," but reserve to themselves the right to vary up to a total of 10 per cent. of the total contract sum, the value of the construction work on site.

The great defect of the specification is unquestionably the total absence of any provision for arbitration, and we strongly advise that no tender be submitted which does not distinctly stipulate that in the final contract *any matters of dispute which may arise during the progress of the contract* between the contractor and the Corporation, shall be referred for decision to an arbitrator to be mutually agreed upon between the two parties, or, failing agreement, to be appointed by an independent party, such as the President of either the Institution of Civil Engineers or the Institution of Electrical Engineers.

RETURN FEEDERS FOR ELECTRIC RAILWAYS.

(*Concluded from page* 999.)

VII.—The Beginning and the End of the Rails are not Connected by Cables with the Power Station.

We shall now consider finally the case in which neither the beginning nor the end of the rails is connected by cable to the power station. In this case the maximum potential difference at both ends of the rails is supposed to be the same as in the centre of a section between two cable connections. This result is obtained by dividing the line into an even number of equal parts, and connecting the cables at uneven division points.

The total current between two connections is $2\frac{C}{r}$, and the rail resistance is $2\frac{R}{r}$; therefore the maximum potential drop between two connections is

$$\Delta = \frac{2\frac{C}{r} \cdot 2\frac{R}{r}}{8} = \frac{C R}{2 r^2}$$

or, since the number of cables m is half the number of the division points r

$$\Delta = \frac{C R}{2 (2 m)^2} = \frac{C R}{8 m^2}.$$

The maximum potential drop is therefore the same as when both the end and the beginning of the line is connected to the power station, the number of cables being the same.

Fig. 9.

The current flowing in each cable has the value $2\frac{C}{r}$; the lengths of single cables, in terms of L the length of the line, are

$$\frac{L}{r}, \frac{3L}{r}, \frac{5L}{r} \ldots \frac{(r-1)L}{r}.$$

The total cross-section is obtained from the equation:

$$S = s_1 + s_2 + \ldots = \frac{1}{K\Delta} \cdot \frac{2C}{r} \cdot \frac{L}{r}[1+3+5+\ldots+(r-1)],$$

$$S = \frac{1}{K\Delta} \cdot \frac{2CL}{r^2}(1+r-1)\frac{r}{4},$$

$$S = \frac{CL}{2K\Delta}.$$

The total cross-section, as in the first case, is therefore independent of the number of cables; it is a constant quantity, and has the same value as in the first case.

In order to determine the sections of single cables, substitute for r its value in terms of m, remembering that $r = 2m$.

$$s_1 + s_2 + \ldots = \frac{CL}{2K\Delta}\frac{1}{m^2}\{1+3+5+\ldots(2m-1)\},$$

$$= \frac{S}{m^2}\{1+3+5+\ldots(2m-1)\}.$$

The section of any cable can thus be found by dividing S by m^2, and multiplying by the corresponding uneven number in the series 1 to $(2m-1)$.

If we take numbers assumed in previous examples, and the number of cables $m = 5$,

$$\frac{S}{m^2} = \frac{CL}{2K\Delta m^2} = \frac{540 \times 18{,}000}{2 \cdot 60 \cdot 30 \cdot 25^2} = 108,$$

then the cross-sections of the five cables are 108, 324, 540, 756 and 972 mm². The lengths of the cables are 1,800, 5,400, 9,000, 12,600 and 16,200 m. If one of the cables is disconnected, it is only necessary to add its section to the two nearest cables, in proportion to their lengths. If, for example, the third cable is disconnected, the cross-section of the second cable becomes

$$s_2 = 324 + \frac{540}{5{\cdot}4 + 12{\cdot}6} \times 5{\cdot}4 = 486 \text{ mm}^2.$$

$$s_4 = 756 + \frac{540}{5{\cdot}4 + 12{\cdot}6} \times 12{\cdot}6 = 1{,}134 \text{ mm}^2.$$

The volume of copper is given by the expression,

$$v = \frac{1}{K\Delta}\frac{2C}{r}\frac{L^2}{r^2}\{1+3^2+5^2+\ldots+(r-1)^2\}.$$

which simplified gives

$$v = \frac{CL^2}{3K\Delta}\left\{1 - \frac{1}{r^2}\right\}$$

Replacing r by its value in terms of m.

$$v = \frac{CL^2}{3K\Delta}\left\{1 - \frac{1}{4m^2}\right\}$$

It is evident that this expression has a maximum value, for $m = \infty$, *i.e.*, for an infinite number of cables; this value agrees with that obtained for an infinite number of cables in the other cases discussed. The expression has a practical minimum value, for $m = 1$; *i.e*, for one return cable connected to the middle of the line. The volume, in this case, taking our previous data, amounts to 24,300 dcm.³. This is exactly half of the volume required when a single cable is connected to the end of the line. In both cases the maximum potential in the rails is the same, namely 12·15 volts.

VIII.—Final Considerations.

Throwing all the expressions for the volume of copper, in the three cases considered, into the same form (m being the number of cables) we get:—

1. When the line is connected at the beginning and the end to the power station,

$$v_1 = \frac{CL^2}{3K\Delta}\left\{1 + \frac{1}{2m^2}\right\}.$$

2. When the line is connected at the beginning to the power station,

$$v_2 = \frac{CL^2}{3K\Delta}\left\{1 - \frac{1}{(2m+1)^2}\right\}$$

3. When the line is connected neither at the beginning nor the end to the power station,

$$v_3 = \frac{CL^2}{3K\Delta}\left\{1 - \frac{1}{4m^2}\right\}$$

For an infinite number of cables, *i.e.*, $m = \infty$, all three values are equal, namely, $v = \frac{CL^2}{3K\Delta}$.

If m is a finite number, the third expression gives the smallest value of v, which for the case $m = 1$ is 50 per cent. of the volume for the first arrangement. The volume for the second arrangement is about 19 per cent. greater than that for the third.

The table given below contains the volumes for all three arrangements with different values of m, *i.e*, for various numbers of connected return cables. The maximum potential drop, Δ, between two cables is also given, and it is easy to see, that with an equal number of cables, the potential drop with the second arrangement is least.

Number of cables m.	Return cables are connected: At the beginning and the end.			At the beginning only.			Neither at the beginning nor the end.		
	Δ	s	vol.	Δ	s	vol.	Δ	s	vol.
0	48·6	...	...	48 6	...	...	48 6	...	...
1	12·15	2,700	48,600	5·40	2,400	28 800	12 15	2,700	24,300
2	3 03	2,700	36,450	1·94	2,592	31,104	3 03	2,700	30,360
3	1 35	2,700	34,200	0·99	2,645	31,740	1 35	2,700	31,500
4	0·76	2,700	33,413	0 60	2,667	32,004	0 76	2,700	31,894
6	0·33	2,700	32,850	0·29	2,679	32,132	0 33	2,700	32,076
10	0·12	2 700	32,562	0·11	2,694	32,328	0 12	2,700	32,319
∞	0 0	2 700	32,400	0 0	2,700	32,400	0 0	2,700	32,400

The greater the number of return cables, the less the differences in copper volume and potential drop. For small potential drop, the second arrangement is the best; it is advisable in this case that the connecting points of the cables should be distributed as uniformly as possible.

Since graphic constructions are better appreciated by engineers than tables, however carefully prepared, the appended diagram (fig. 10), is given, in which curves are

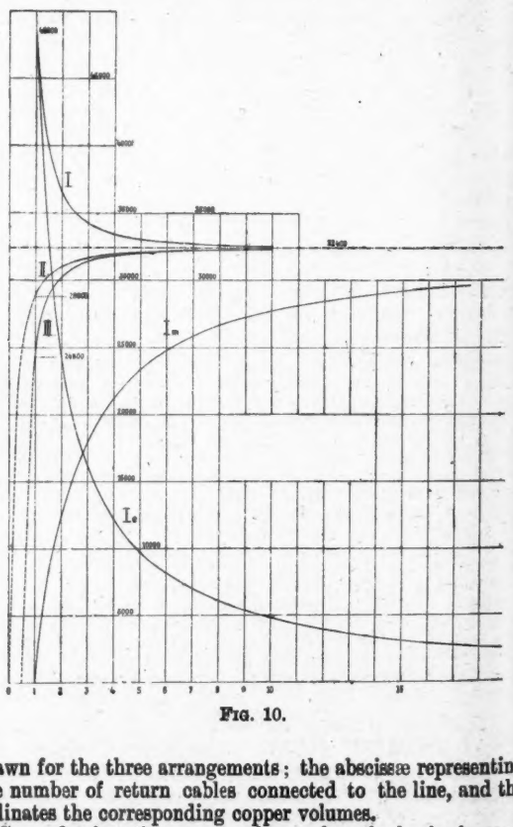

Fig. 10.

drawn for the three arrangements; the abscissæ representing the number of return cables connected to the line, and the ordinates the corresponding copper volumes.

Curve I. gives the copper volume when the beginning and the end of the line are connected to the power station.

Curve II. when the beginning only is connected, and Curve III. when neither the end nor the beginning is connected to the power station.

The copper volume in Case I. is made up of that of the end cable, and that of the intermediate cables; and in order to show the influence of the end cable on the total volume, its volume is represented by the curve I_e, while that of the intermediate cables is represented by the curve I_m. The sum of the ordinates of these two curves is for any given abscissæ equal to the corresponding ordinate of Curve I.

From the diagram it is evident that the copper volume in cases II. and III. is already almost equal with the three cables. It must not be forgotten, however, that the maximum potential drop in the rails is greater in case III. in the ratio 1·35 to ·99.

With six cables, the copper volume in all three cases is nearly equal. (The dotted parts of the curves in II. and III. have no practical value since we cannot have fewer than one cable.)

If at the end of the line a double potential difference is allowed, the end cable being removed, then I_m would represent the copper volume, and it would in this respect be the best arrangement.

It should be noted that high insulation is not required for these return feeders, and that in the case of straight lines of railway all the cables can be laid in one conduit; both of which circumstances will tend to reduce the cost of the cables to the cost of the copper.

TESLA ON ENERGY.

By T. H. MURAS.

In the *Century Magazine* for June there appears an article of 36 pages by Nikola Tesla on "The Problem of Increasing Human Energy, with Special Reference to the Harnessing of the Sun's Energy." Human energy here means the total power available to humanity. Increase of it is to be obtained in the first place by adding to and improving the condition of humanity, and for this purpose the author emphasises the necessity of increasing the productivity of the soil. He states: "the key for the solution of the all-important food problem" to be the cheap production of compounds of nitrogen to replace that withdrawn from the soil by crops, and proposes to produce such compounds by the use of electric discharges of high frequency in air, and, in fact, to develop Cavendish's experiment on the production of nitric acid into a manufacture. The necessary electrical energy is to be obtained from waterfalls. In this proposal the author appears to suffer from the incomplete knowledge with which a scientific man is sometimes unconsciously afflicted when he looks over the paling surrounding the little scientific plot that he has laboriously cultivated. Mr. Tesla does not mention, and apparently is unaware of the fact, that any necessary amount of nitrogen can be "fixed" in the soil by the prosaic agricultural method of growing leguminous plants, such as clover, as one of the crops in a rotation, these co-operating with special bacteria, which fix and supply nitrogen to their roots by means of energy derived in carbon compounds from the plants. In this practically simple process the energy used is obtained by the plant directly from the sun's radiation, and to anyone whose vision is not absolutely bounded by the walls of a laboratory, the proposed production of nitrogen compounds by the waterfall and electric method must appear a very crude substitute. It is true that agricultural methods are inefficient in various ways, and especially as regards the proportion of the sun's available power utilised; but this appears comparatively unimportant, in view of the almost unlimited supply of such power. It would appear to a commonplace individual that patient work in the scientific study of such bacteria and crops, with a view to their more efficient working, with the help of artificial selection or otherwise, is a far more promising "key for the solution of the all-important food problem" than any new method at present in prospect for obtaining human energy from the sun's radiation or otherwise.

In the second place, Tesla proposes to substitute mechanical automata, more or less controlled by high frequency electromagnetic radiations, for human beings in warfare. Judging from recent events, the supply of "human energy" for this purpose does not appear to be limited, in this country at any rate; the real demand appears to be for an outlet for existing energy, and warfare in South Africa is preferred to office work in England.

The remainder of the article contains a number of suggestions as to obtaining energy for mechanical and chemical purposes directly from sunlight, and from the heat of the earth and atmosphere; and its transmission by high frequency electric currents through the upper part of the atmosphere. The article does not contain one exact measurement or statement of an attained result, but it is accompanied by photographs of remarkable electric discharges, extending to 100 feet long, in the air. These are apparently obtained by high frequency currents in large inductive circuits, tuned by means of condensers to rates from 50,000 to 130,000 ~ per second, the pressure obtained being about 12 million volts! No indication is given as to how these figures are arrived at, but Mr. Tesla is obviously not a believer in the hypothesis (based on experiments) that a pressure much exceeding 100,000 volts cannot exist between any two conductors at any distance apart in air, on account of discharge occurring in brush or "spark" form. Electricians, and probably other people, would have been grateful if a few pages of the article had been devoted to a precise account of these electrical experiments, especially as his experiments have caused Mr. Tesla to state, relative to the work of Hertz, "I have long since ceased to look upon his results as being an experimental verification of the poetical conceptions of Maxwell." As it is, the article is mainly of interest on account of the pretty and somewhat startling photographs.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1900.

Compiled expressly for this journal by W. P. Thompson & Co. Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

10,270. "Improved low tension exploder or electric shot firing battery." G. Evans. Dated June 5th.

10,273. "Improvements in controller regulators for electric motors." H. J. Haddan. (The Garton Daniels Company, United States.) Dated June 5th. (Complete.)

10,312. "Improvements in and connected with wireless telegraphy." C. E. Wilson. Dated June 5th. (Complete.)

10,318. "Improvements in electric storage batteries and conducting plates therefor." J. C. Fell. (S. L. Wiegand, United States.) Dated June 5th. (Complete.)

10,319. "Improvements in electric storage batteries." J. C. Fell. (S. L. Wiegand, United States.) Dated June 5th. (Complete.)

10,323. "Improvements in telephone cables, and in apparatus for producing same." H. Cassirer. Dated June 5th. (Complete.)

10,326. "Improvements in or relating to electrical stop-gear for steam and other engines or machinery." Dated June 5th.

10,348. "Electro-magnet machine." J. V. D. Ploeg. Dated June 6th. (Complete.)

10,357. "Improvements in and relating to electrical apparatus for surgical and other purposes." J. J. Hynes and P. M. Randall. Dated June 6th. (Complete.)

10,361. "An improved flexible electrical conductor from any point of which a current may be taken." J. A. Halford. Dated June 6th.

10,362. "Improvements in caps for glow lamps." J. A. Halford. Dated June 6th.

10,363. "Improvements in electric contacts." J. A. Halford. Dated June 6th.

10,375. "Improvements in the construction of plates for accumulators or secondary batteries discharging heavy currents." J. Garassino. Dated June 6th.

10,423. "Improvements relating to electric ignition devices for internal combustion or explosion engines." S. F. Edge and F. Wills. Dated June 7th.

10,426. "Electric safety appliances for lifts." F. Garside, W. Carter, and The Hydraulic Engineering Company, Limited. Dated June 7th.

10,437. "Improvements in or relating to electrodes for batteries." A. Mackenzie. Dated June 7th.

10,444. "Improvements in or connected with electric incandescent lamps of the refractory conductor type." G. Patrouilleau. Dated June 7th. (Complete.)

10,451. "A containing box for electrical resistance material." A. H. Mayes. Dated June 8th.

10,460. "Improvements in or connected with electric cars." A. Ried. Dated June 8th.

10,476. "An improved adjustable electric igniter or spark producer." A. Braun and The Erste Osterreichische Motorfahrzeug-Fabrik. Dated June 8th. (Complete.)

10,498. "Improvements in switches." W. R. Ridings and Veritys, Limited. Dated June 8th.

10,502. "Improvements in telephone systems." G. RITTER. Dated June 8th. (Complete.)

10,509. "Improvements in electrical switches." N. N. HAIGH and B. SHORE. Dated June 8th.

10,511. "Improvements in the manufacture of negative or spongy lead plates or elements for secondary batteries or electrical accumulators." THE ELECTRICAL POWER STORAGE COMPANY, LIMITED, H. W. BUTLER, and J. H. MAY. ated June 8th.

10,542. "Improvements in and connected with electric wall plugs." H. OPENHEIMER. (Aktiengesellschaft Mix & Genest, Germany.) Dated June 9th.

10,543. "Arrangement for limiting the length of the fuse of electric cut-outs." H. OPPENHEIMER. (Aktiengesellschaft Mix & Genest, Germany.) Dated June 9th.

10,544. "Improvements in and connected with quick-break switches." H. OPPENHEIMER. (Aktiengesellschaft Mix & Genest, Germany.) Dated June 9th.

10,545. "Improvements in and connected with switches or keys for electric lampholders." H. OPPENHEIMER. (Aktiengesellschaft Mix & Genest, Germany.) Dated June 9th.

10,550. "Improvements relating to ammeters." W. E. EVANS. (Gans and Goldschmidt, Germany.) Dated June 9th.

10,579. "Improvements in and relating to electrically-controlled apparatus for shifting and locking railway points." SIEMENS BROS. & Co., LIMITED. (Siemens & Halske, Actiengesellschaft, Germany.) Dated June 9th. (Complete.)

10,580. "Improvements in electric furnaces of great power." O. IMRAY. (F. Morani, Italy.) Dated June 9th.

10,587. "Improvements in feeding and regulating mechanism for electric arc lamps." W. H. ARUNDEL. Dated June 9th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

14,399. "Improvements in or connected with electric measuring instruments." A. B. Blackburn and W. T. Spence. Dated June 29th, 1898. Relates to a permanent or electro-magnet carrying three pole-pieces the outer two of which are together equal in section to the middle one from which they are separated by thin spaces, in which the magnetic fields are uniform along about 90° of the pole-pieces. The middle pole-piece is enclosed by a movable coil which is carried by arms on an ivory or like hub provided with hard steel end pins and with a copper counterweight. The pins turn in jewels carried on non-magnetic bridges screwed to the pole-pieces. The pins are connected by flat spiral springs to fixed arms through which the coil is electrically connected, and by which its movement is controlled. The springs may act together or in opposition, being in the latter case made with different strengths or temperature expansion coefficients in order to compensate for resistance variations. The magnet pole-pieces may be made by turning rings which are afterwards cut in halves by slits parallel to a diameter. The free ends of the pole-pieces are notched to reduce magnetic leakage to the adjacent ends of the magnet. The coil carries a pointer in front of a scale attached to the pole-pieces. The magnet is fixed in a case having a magnetic front, back and periphery; the periphery is enclosed in a corrugated copper or brass covering. The terminal and attachment screws are set in long nuts, which are insulated from and secured in the case by porcelain collars and insulating cement. Specification No. 17,577, A.D. 1896, is referred to. 5 claims.

14,902. "Improvements in telephone cables." L. T. B. Saunderson. Dated July 6th, 1898. Cables for telephonic communication are formed with one or more pairs of insulated wires enclosed in a flexible metallic sheath. The sheath consists preferably of an overlapping spiral of metal foil, and an open spiral of wire laid over the same. The sheaths of each pair may be in contact, and are covered with a common protective coating. The sheaths are earthed in sections or at each end. 1 claim.

14,958. "Improvements in electric motors and dynamo-electric generators." F. H. Varley. Dated July 7th, 1898. Relates mainly to the construction of continuous or alternating current electric motors, but the improvements are also applicable to generators. The iron cores of the armature and field magnets are constructed of plates of soft permeable iron and, to reduce magnetic resistance, that part of the core between the winding and the pole surfaces is made as short as possible. Multipolar armatures are employed consisting of a series of double-poled electro-magnets attached to a driving hub. In one form of motor the field cores are each built up of plates of soft iron, bent at right angles, and overlapping in such a manner that the yokes on which the coils are wound contain twice as many plates as the poles. In a modification each of the two magnets has a single yoke instead of a pair. Another form of motor is provided with a multipolar field magnet and multipolar armature both of which are wound with coils arranged so as to be parallel to the plane of rotation. The armature coils may, however, be wound through slots in a pair of laminated discs connected together by a laminated yoke, in which case the windings are parallel to the axis of rotation. In some cases, especially in large motors, the tendency to sparking is prevented by winding each of the armature coils with two or more wires and connecting these to successive commutator sections, which are correspondingly increased in number. 6 claims.

14,983. "Improved means of making connection with electric cables." R. J. Hatton and W. T. Henley's Telegraph Works Company, Limited. Dated July 9th, 1898. Couplings or connections for the ends of concentric, &c., cables with means for sealing the insulation. In one form an earthenware case has a small opening at one end for the bared inner conductor to which a connection is attached. The outer conductor is fitted with a connection and the casing is closed by a plug. The casing is filled with insulating material before the plug is screwed in. In the case of a triple cable two perforated plugs are provided, and with a single cable the plug is solid. 1 claim. (No patent granted on this application.)

15,118. "Protective device for incandescent electric lamps." R. Kas. Dated July 9th, 1898. Incandescent lamps for use in explosive atmospheres, by miners or others, are mounted so that pressure on globes enclosing them disconnects them electrically. The lamp is supported in a globe and in front of a reflector by three hooked wires. The wire is carried by the reflector, which is screwed on a ring fixed on a back plate. The globe is carried by rings loose on the ring so that they can be moved backward a small distance, against the pressure of four wire springs, which are carried by the ring and bear against parts of the ring. A cross bar on the ring extends through slots in the ring. Electric connection to the lamp is effected by a switch pivoted on a connecting plate and pressed towards a fixed contact by a wire spring. The switch is shown as held away from the contact by the interposition of a sliding stop which is pressed upward by a spring. The lamp is put in circuit by pulling down the stop which then releases the switch, but, if the globe is pressed backward, the cross bar opens the switch, allowing the stop to be again interposed by its spring. In a modification, the sliding stop is not accessible from outside the globe, so that it cannot be withdrawn after the switch has once been opened; a separate sliding switch is also provided. 4 claims.

15,149. "Improvements in electric arc lamps." H. H. Lake. (Stralsunder Bogenlampenfabrik Gesellschaft mit Beschrankter Haftung.) Dated July 9th, 1898. A clockwork feed is controlled by a shunt and series coils acting independently, so that feeding takes place only when the current is below normal, and the pressure above normal, simultaneously. The arc is struck by another series coil which acts on a core carrying the upper carbon, and which, in the arrangement described, is hung by a chain connected with the gearing and a counterweight. The gearing drives an air fan. The shunt coil has a fixed core and acts on an armature which is held by a spring so that an arm of it engages a star wheel on the fan spindle unless the pressure is above normal. The series coil acts on a horizontal lever in opposition to a spring, which holds an arm of the lever below and clear of the air fan when the current is below normal. 2 claims.

15,039. "Improvements connected with collectors for electric railways." H. G. Taylor and R. Gardner. Dated July 8th, 1898. Relates to collectors for electric railways and tramways with overhead conductors. The swivelling support is mounted on the trunnion on the base between two rows of ball bearings secured by the cap and screw. The springs which lift the pole are attached to hooked arms on the hinged pole socket and to hooked ends of the T headed bolt, which is adjustably secured on the support by lock nuts. A spring buffer is provided to check the pole if the trolley escapes from the conductor. 7 claims.

15,040. "Improvements in automatic circuit breakers." The British Thomson-Houston Company, Limited. (E. M. Hewlett.) Dated July 8th, 1898. Relates to apparatus for cutting out any one of a number of dynamos running in parallel should the electromotive force of the one be lowered a predetermined amount below that of the others. The core is wound with two coils, the former in series with the generator and the latter adapted to be connected in shunt with the mains. The movable armature carries contact fingers, the first striking a contact when it falls away from the core, and the second a contact on its return. Inclined guards prevent contact otherwise. 11 claims.

15,100. "Electrical influence machines." W. R. Pidgeon. Dated July 9th, 1898. A machine may consist of two oppositely rotating discs, each carrying several concentric projecting cylinders, containing conducting sectors of such radii that these on one disc pass between those on the other. For this machine the sectors may be attached to thin sheet ebonite which is rolled into cylindrical form in one or more layers, and is fixed by screws in circular grooves cut in the discs. Contact knobs are fixed on the outsides of the discs. Otherwise sheet metal sectors may be supported in a mould shaped to form a disc with projecting cylinders in one piece of plastic rubber which is afterwards vulcanised. 5 claims.

15,191. "Improvements in means or apparatus for use in protecting iron and steel by producing magnetic oxide thereupon." A. S. Bower. Dated July 11th, 1898. In coating iron and steel with magnetic oxide, an injector or other like apparatus is employed to cause a circulation of the gases so as to reduce the consumption of "live" steam. Air or other gases may also be introduced, as desired, into the circulation for removing rust, heating the pipes, &c. The circulating gases are perfectly superheated, either by passing through tubes, or through masses of brickwork heated on the regenerative principle. For cooling the coated articles, the gases may be cooled during the circulation. The fireplace is deep and serves as a gas producer, and the gases are burnt in a chamber in which are arranged the pipes for superheating the steam, &c. The iron articles are placed in the chamber. The gases are caused to circulate by a steam jet, which extracts them from the chamber through the perforations and slits in the pipe. 8 claims.

15,208. "Improvements in electric heaters." E. E. Gold. Dated July 11th, 1898. Owing to the intricate complications of resistances, contacts, &c., this invention does not allow of abridgment. 21 claims.

15,346. "Improvements in secondary batteries or electric accumulators." J. J. Courtenay. Dated July 12th, 1898. The grid is in two parts or is made of one piece of material doubled on itself, and is provided with a number of inturned pieces struck up from the grid itself and serving to hold the active material in place. 1 claim.

15,348. "Improvements in phonographs or graphophones." M. V. Gross. Dated July 12th, 1898. Consists of coin-freed phonographic apparatus driven by an electric motor. 8 claims.

15,349. "Improvements in and relating to moulds for casting electrodes." E. Franke. Dated July 12th, 1898. Relates to a mould for casting gratings made up of thin plates or ribs with a solid core. One half of the mould is fixed on the pedestal, while the other half can be moved to and fro by a rack and pinion. The faces of the mould are formed of two series of plates, one series having zig-zag edges, and the other having straight edges, which coincide with the bottoms of the notches. The notched plates are fixed to the fixed frame, but the plates are all connected to a movable frame which can be moved to and fro by eccentrics turned by an external handle to which they are connected by toothed gearing. The object of this movement of the plates is to eject the castings from the mould. The mould is also fitted with horizontal ribs to receive which there are slots in the movable plates. A hand mould is described in which the movable plates are actuated by inclined planes brought into action by knocking their projecting ends. 6 claims.

15,430. "Improved diaphragm for electrolytic apparatus." W. P. Thompson. (E. Longguth.) Dated July 18th, 1898. Relates to diaphrams which are gas and water tight, are not attacked by the electrolyte or the products produced in the operation, and offer little resistance to the passage of the current. They are formed of a network or grating of iron, nickel, cobalt, copper or other suitable metal, the network being entirely filled up with an amalgam of copper, lead, silver or other suitable metal, the mercury being always in excess. The amalgam is applied in a warm pasty state, and hardens on cooling. An explanation of the reactions which take place is given when electrolysing potassium-chloride solution to obtain chlorine and caustic potash. 2 claims.

15,443. "Improvements in electrical switches." Veritys, Limited, and L. J. Steele. Dated July 14th, 1898. A shutter or screen is moved between the contacts to break the arc. In one arrangement a pair of fixed contacts are arranged behind or on the back of an insulating plate having two slots through which the moving contacts pass. A sliding shutter is connected by the links with the switch arm, and closes the slots when the switch is off. The handle, which is spring controlled, is fitted with an adjustable stop. The switch may have a hinged back for obtaining access to the parts. In modified arrangements, a pair of shutters is employed and the shutter or shutters may be arranged to rotate. Instead of connecting the shutters directly to the switch arm, they may be operated by weights or springs, which are released by the arm. The switch may have locking mechanism for holding it in either position. 6 claims.

15,486. "Improvements in or relating to electrical time switches." T. B Browne and F. L. Martineau. Dated July 14th, 1898. Relates to time switches. The switch arm is moved to make or break contact by means of two cams mounted on an axle driven by suitable clock or other mechanism through a wheel. The cams are mounted on sleeves and are adjusted by wheels fitted with pointers, the times being shown on a dial. A spring or other means secures a quick break. 8 claims.

15,509. "Improvements in electric blocks." H. Whidbourne and A. E. J. Ball. Dated July 15th, 1898. Relates to electric clocks. A current is sent from a master clock every time an arm which turns with the escape wheel and bears two pins, catches the lower bent end of a contact key which is pivoted on the escapement anchor. This occurs and acts on terminals during the locking, and the movement of the anchor to give the escape disengages the contact key from the revolving arm. The contact key may be placed further from the anchor arbor. 4 claims.

15,573. "An improved process for the manufacture of metal paper by electro-metallurgy." J. Landauer. Dated July 15th, 1898. To make metal paper, a cathode is formed of a plate of brass or alpacca (silvered German silver) carefully polished and freed from grease on each side. The plate is well rinsed and hung in a bath consisting of a dilute solution of sulphantimoniate. After a coating of antimony has been deposited the plate is transferred to a copper bath, and a coating of copper deposited. It is then removed and dried after which a covering of paper, cardboard, linen or the like is glued or cemented on. Finally the edges are filed and the metallic coatings and their backing stripped off. According to the length of time the antimony was depositing so the finished surface will show the colour of antimony or that of the highly polished copper beneath. 1 claim.